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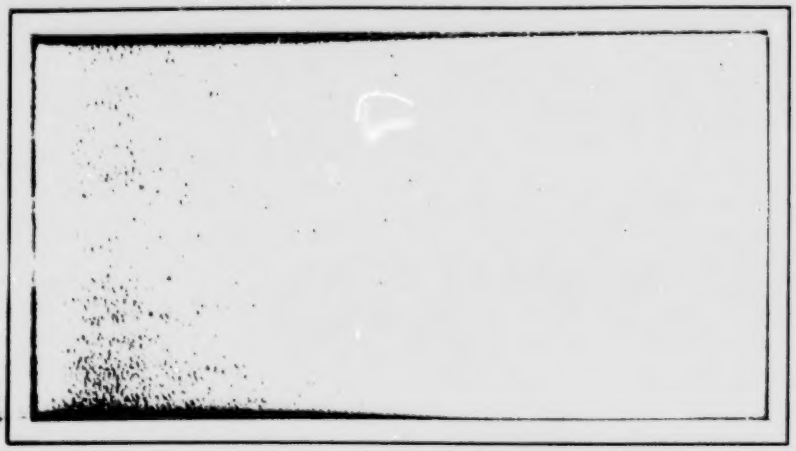

DEPARTMENT OF CHEMICAL ENGINEERING AND APPLIED CHEMISTRY

NUMERICAL SIMULATION
OF
STEAM INJECTION IN BITUMEN
AND HEAVY OIL RESERVOIRS
PHASE II
VOLUME I

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EXECUTIVE SUMMARY

Numerical simulation has become an important tool in the design and evaluation of oil recovery strategies. It is particularly important in the marginally economic processes contemplated for heavy oil deposits. One such process, that has shown excellent promise, is the horizontal-well gravity-drainage steam injection process, which involves the drilling of a long well (as long as 1 kilometer) at the bottom of the pay zone, parallel to and just above the base rock. Steam is injected through one or more vertical wells drilled to terminate in close proximity to the horizontal well. Ideally, the oil would be warmed along the entire axis of the horizontal well, and could be produced at very high rates.

In field trials of the horizontal-well process, it has been found that the formation is heated only in a spherical zone around the injection well, forming a steam chamber with very limited extent along the horizontal well. If more complete development of the steam chamber along the horizontal well could be achieved, a substantial improvement in process performance could be expected. Accurate numerical simulation of the process could provide the necessary insight to understand this process so that modifications and improvements could be made.

All steam injection simulators are plagued by two problems, which compromise their application. First, spurious oscillations in time, either in the injection pressure or injection rate, depending on the boundary conditions imposed. Second, numerical dispersion washes out steep gradients and fronts, and leads to significant errors in the prediction of steam front advance rates. Both problems can be traced to the large gradients in state variables which exist primarily in the vicinity of steam fronts. These gradients are often so large that they can reasonably be modelled as discontinuities, especially when using the grid spacings which are feasible with conventional simulators.

To resolve these two problems, we have undertaken, in the present work, to develop a two-dimensional simulator to track the location of the steam front explicitly within a finite-difference procedure, so that the phenomena at the steam front can be more accurately simulated. In particular, we have adopted a so-called front-fixing method which maps the steam front location onto a stationary surface through a time-dependent coordinate transformation. This allows the more accurate representation of the steam front since some of the solution mesh grid points lie exactly on the steam front at all times, and other

grid points can be conveniently placed close to the steam front to provide accurate representation of steep gradients. The time-dependent coordinate transformation is computed as part of the solution.

In this report, details of the mathematical analysis required to incorporate the time-dependent coordinate transformation are given. Details of the finite-difference representation are also provided.

The simulator was tested using physical properties typical of the Cold Lake bitumen deposits. These physical properties were chosen, based on a comprehensive literature search, which had been performed in a previous phase of this project. The simulator predicted what seemed to be a physically realistic behaviour for the initial stages of steam chamber development. However, the vapour saturation at the steam front on the ceiling of the steam chamber dropped rapidly towards the residual vapour saturation value. This behaviour seems physically unreasonable, and is attributed to a deficiency in the finite-difference formulation of the steam front equations. The unique feature of the ceiling is the countercurrent flow which apparently cannot be properly accommodated by the simulator. Whether or not it is physically realistic for the vapour saturation to drop to zero, the resulting disappearance of the vapour saturation discontinuity changes the nature of the finite-difference equations, so that they do not have a unique solution. Also, a related problem with the simulator is that it is much slower than it should be, mainly because it requires too many iterations per time step.

In view of the problem with the vapour saturation at the ceiling of the steam chamber, and in view of the excessive number of iterations per time step required by the simulator, we have proposed a modified finite-difference approximation procedure. The proposed modification would replace a few of the finite-difference equations with equations which relate the velocity of the steam front to the "characteristics" of the governing hyperbolic partial differential equations. There is limited published work which is directly applicable to problems as complex as the one at hand. However, the discussion in the report indicates the relevance to the present problem of what is available. There is convincing evidence to suggest that a simulator based on this modified procedure will not encounter the same difficulties as were experienced in the present study, and will be much more useful than the current simulator for studying the horizontal-well steam injection process.

PRÉCIS À L'ADRESSE DES ADMINISTRATEURS

La simulation informatisée est devenue un moyen important pour établir et évaluer des stratégies utilisées dans l'extraction du pétrole. Son emploi est particulièrement important par rapport aux procédés peu économiques envisagés pour l'exploitation des gisements de sables bitumineux. Un procédé de ce type, qui s'est révélé très prometteur, c'est le procédé d'injection de vapeur d'eau par un puits horizontal et de drainage-par-gravité. Il consiste à perforer un long puits (qui s'étend parfois jusqu'à un kilomètre de longueur) au fond de la zone productive, parallèle à la roche de base et tout juste au-dessus d'elle. On injecte la vapeur dans un ou plusieurs puits verticaux qui aboutissent à proximité du puits horizontal. Idéalement, on pourrait chauffer le pétrole le long de l'axe entier du puits horizontal, et l'extraire à grands débits.

Pendant des essais pilotes du procédé puits-horizontal, on a découvert que la formation est chauffée seulement dans une zone sphérique autour de l'extrémité du puits d'injection, formant une chambre à vapeur d'une étendue très limitée le long du puits horizontal. Si l'on pouvait réaliser un développement plus extensif de la chambre à vapeur le long du puits horizontal, on pourrait s'attendre à une amélioration considérable du fonctionnement du procédé. Une simulation précise du procédé par ordinateur pourrait nous donner les aperçus essentiels pour mieux comprendre les modalités de ce procédé, de sorte que l'on puisse les modifier et les améliorer.

Deux problèmes génants se posent toutefois dans l'utilisation des simulations informatisées du procédé d'injection de vapeur d'eau et en compromettent l'application. En premier lieu, c'est celui des oscillations contrefaites du temps, soit de la pression d'injection soit du débit d'injection, selon les conditions aux limites imposées. En second lieu, la dispersion numérique efface les gradients raides et les fronts, et entraîne des erreurs importantes dans la prédiction des vitesses d'avance du front de vapeur. On a pu trouver l'origine de ces deux problèmes dans les grands gradients des variables qui existent principalement dans le voisinage des fronts de vapeur. Ces gradients sont souvent si grands qu'on pourrait raisonnablement les modeler comme des discontinuités, surtout quand on utilise un nombre de points de discrétisation dans l'espace qui est faisable avec l'emploi des simulateurs conventionnels.

Pour résoudre ces deux problèmes nous avons entrepris, dans le projet actuel, de développer un simulateur à deux dimensions afin de suivre explicitement l'emplacement du front de vapeur au moyen d'une méthode des différences finies, pour simuler plus précisément les phénomènes situés au front de vapeur. En particulier nous avons choisi une méthode, nommé "méthode pour immobiliser le front", qui projette l'emplacement du front de vapeur sur une surface immobile au moyen d'une conversion des coordonnées dynamique. Celle-ci permet une représentation plus précise du front de vapeur puisque quelques-uns des points de la maillage spatiale utilisée sont toujours situés exactement sur le front de vapeur, et on peut mettre d'autres points de la maillage à proximité du front de vapeur pour établir une représentation précise des gradients raides. On calcule la conversion des coordonnées dynamique comme une partie de la solution.

Ce rapport contient les détails de l'analyse mathématique exigée pour incorporer la conversion des coordonnées dynamique. Il comprend également des détails de la représentation aux différences finies.

Pour essayer le simulateur, on a utilisé des propriétés physiques typiques des gisements de sables bitumineux de Cold Lake. Le choix de ces propriétés physiques se base sur une enquête exhaustive dans les publications pertinentes que nous avons faite lors d'une étape antérieure de ce projet. Le simulateur prédit ce qui semblait être un fonctionnement physique réaliste des phases initiales du développement de la chambre à vapeur. Toutefois la saturation de vapeur au front de vapeur près du plafond de la chambre à vapeur tomba rapidement vers la valeur de la saturation résiduelle de vapeur. Ce comportement semble illogique sur le plan de la physique, et est attribuable à un défaut dans la formulation aux différences finies des équations du front de vapeur. La caractéristique unique du plafond est l'écoulement à contre-courant que le simulateur ne semble pas pouvoir réprésenter adéquatement. Peu importe s'il est vraisemblable sur le plan de physique que la saturation de la vapeur chute à zéro, la disparition résultante de la discontinuité de la saturation de la vapeur modifie la nature des équations aux différences finies, de sorte qu'il n'en existe pas de solution unique. L'emploi du simulateur comporte un autre problème connexe; le simulateur est beaucoup trop lent qu'il ne devrait être, surtout parce qu'il exige trop de réiterations par pas de discrétisation dans le temps.

Vu le problème de la saturation de vapeur au plafond de la chambre à vapeur, et vu le nombre excessif des réiterations, par pas de discrétisation dans le temps, exigé par le simulateur, nous avons proposé une méthode modifiée d'approximation aux différences finies. La modification proposée remplacerait quelques-unes des équations aux différences finies par des équations qui établissent un rapport entre la vitesse du front de vapeur et les "caractéristiques" des équations aux dérivées partielles de type hyperbolique qui régissent. À l'heure actuelle il y a peu de travaux publiés qui semblent avoir une application directe aux problèmes aussi complexes que nous avons traités ici. Nous signalons toutefois, dans cette étude, les publications ayant quelque rapport avec les problèmes de notre enquête. D'après des preuves convaincantes, il y a tout lieu de croire qu'un simulateur conçu selon cette méthode modifiée ne rencontrera pas les mêmes difficultés qu'on a trouvées pendant le projet actuel, et on peut espérer qu'il sera beaucoup plus utile que le simulateur actuel pour étudier le procédé d'injection de vapeur par puits horizontal.

TABLE OF CONTENTS

Executive Summary i

Précis à l'adresse des administrateurs iii

Table of Contents vi

List of Figures ix

List of Tables x

Nomenclature xi

1. Introduction 1

References for Chapter 1 9

2. The Governing Equations 12

2.1 The Transport Equations 12

2.2 The Matching Conditions 13

Reference for Chapter 2 20

3. The Coordinate Transformation 21

3.1 The Transformation of the Transport Equation 22

3.1.1 The Time-Derivative Terms 24

3.1.2 The Flow Terms 25

3.1.3 Condensation and Source Terms 25

3.1.4 The Transformed Transport Equations 26

3.2 The Transformation of the Matching Conditions 26

3.2.1 The Normal Vector 26

3.2.2 The Normal Gradients 27

3.2.3 The Normal Component of the Front Velocity 30

4. The Finite-Difference Approximation 32

4.1 Discretization of the Transport Equations 32

4.1.1 Left Side of Equation (2.1) 32

4.1.2 Right Side of Equation (2.1) 34

4.2 Discretization of the Matching Conditions 37

4.3 Which Discretized Equations Should Be Used? 38

4.4 The Bandwidth Problem 42

4.4.1 Alternatives 42

References for Chapter 4 44

5. A Survey of Reported Physical Properties for the Cold Lake Reservoir 45

5.1 Introduction 45

5.2 Initial Reservoir Conditions 46

5.3 Reservoir Matrix Properties 51

5.3.1 Porosity 51

5.3.2 Absolute Permeability 51

5.3.3 Relative Permeability 52

5.3.4 Compressibility and Thermal Properties 52

5.4 Bitumen Properties 55

5.4.1 Compressibility and Thermal Properties 55

5.4.2 Density 55

5.4.3 Viscosity 56

5.4.4 Molecular Weight 57

5.4.5 Solubility of Methane in Bitumen 57

5.4.6 Enthalpy of Solution of Methane 59

References for Chapter 5 60

6. Results and Proposed Extensions of the Coordinate Transformation Procedure . 66

6.1 Results 66

6.2 The Proposed Modifications to the 2-D Simulator 75

6.2.1 Motivation: The Buckley-Leverett Problem 75

6.2.2 Generalizations for the Steam Injection Problem 79

6.2.2.1 Gravity 80

6.2.2.2 3-Phase Flow 81

6.2.2.3 Two Spatial Dimensions 81

6.3 The Extension of the Coordinate Transformation Procedure to Three Dimensions 83

References for Chapter 6 84

7. Conclusions 86

LIST OF FIGURES

1.1 - A vertical cross-section through the steam chamber, orthogonal to the horizontal well. 6

1.2a - Front location in the cylindrical coordinate system. 7

1.2b - Front location in the transformed coordinate system. 7

2.1 - Location of the control volume used to derive the matching conditions. . . . 14

2.2 - The control volume used to derive matching conditions. 15

2.3 - Material balance on the control volume of figure 2.2 16

3.1 - Three vectors used in the transformation of $\underline{V}_f \cdot \underline{n}$. 29

6.1 - Normalized pressure profiles along a vertical cross-section ($\theta = \pm 90°$) through the steam chamber. 68

6.2 - Volumetric injection and production rates as a function of time. 69

6.3 - Motion of the steam front as a function of time. 70

6.4 - Vapour saturations at the steam front as a function of time for the 8×7 grid. . 71

6.5 - Vapour saturations at the steam front as a function of time for the 4×6 grid. . 72

LIST OF TABLES

2.1 - Material balance on species *c* in phase *p*. 17

4.1 - The order of the equations and primary unknown variables at the steam front. . 41

5.1 - A survey of commonly reported reservoir properties. (a 4 page table) 47

5.2 - Relative permeability data. 53

5.3 - The relative permeability tables of Coats[8]. 53

5.4 - Miscellaneous bitumen and formation properties. 54

NOMENCLATURE

This list does not include the discussion, in section 6.2 of this report, of literature in which a different nomenclature system is used.

a (with subscripts)coefficients in a least-squares fit

b_0, b_X, b_Ycoefficients in a least-squares fit

$b(t)$ a function representing the upward drift of the steam chamber

B a vector defined in figure 3.1

c_p heat capacity

c_n, c_s scale factors

D_t a differential operator defined in equation (3.13)

D^X a differential operator defined in equation (3.14)

D^Y a differential operator defined in equation (3.14)

D coefficient of diffusivity

$f_p(S_p)$fractional flow ratio

F an abbreviation, defined in equation (4.28)

g acceleration due to gravity

G_2 an abbreviation, defined in equation (5.04)

h enthalpy

H_m modified harmonic mean, defined in equation (4.01)

J Jacobian

k absolute permeability

k_r relative permeability

k_{rg} relative permeability of the vapour phase

k_{rog} relative permeability of the hydrocarbon phase with respect to the vapour phase

k_{rw} relative permeability of the water phase

k_{row} relative permeability of the hydrocarbon phase with respect to the water phase

k_T thermal conductivity

$L(t)$ the distance from the steam front to the centre of the transformed coordinate system parallel to the horizontal well

M condensation rate

$\overline{M}$ concentrated condensation rate

MW molecular weight

$\underline{n}$ unit vector normal to a line or curve (its direction depends on the context)

N_c the number of components in the hydrocarbon-phase

N_F the value of j at the steam front

N_r number of grid points in the r-direction

N_θ number of grid points in the θ-direction

o According to the standard terminology of asymptotic analysis, the expression $f(\Delta S) = o(\phi(\Delta S))$ means that as Δs tends to zero, the ratio $f(\Delta s)/\phi(\Delta s)$ also tends to zero. Little "o" should not be confused with big "O", which has a different standard meaning.

P pressure

q source term

Q_T total volumetric flow rate

r the radial coordinate

r_c the radial coordinate coordinate in the untransformed polar coordinate system

r_t the radial coordinate in the transformed coordinate system

$R(\theta,t)$, $R(t)$ the distance from the steam front to the centre of the transformed coordinate system which is perpendicular to the horizontal well

s arc length

$\underline{s}$ unit vector tangential to a line or curve

S saturation

t time

T temperature

u general dependent variable

U generalized vector of unknowns

$\underline{V_f}$ the velocity of the steam front

w mole fraction in a deliberately unspecified phase

x mole fraction in the (liquid) hydrocarbon phase

$\hat{x}$ weight fraction in the (liquid) hydrocarbon phase

X horizontal position

y mole fraction in the vapour phase

Y vertical position

Z the third Cartesian coordinate direction

α compressibility

β coefficient of thermal expansion

δ change

θ angle coordinate

λ mobility

μ viscosity

ρ density

τ transmissibility

ϕ porosity

Φ pressure minus hydrostatic pressure $\Phi_p = P - \rho_p g Y$

σ sign of the condensation term (-1 for the vapour phase, +1 for the liquid phases)

Subscripts

A Athabasca

b bitumen

c component

C Cold Lake

f steam front

g gas/vapour

irr irreducible

i θ-direction

j r-direction

$jF-$ the value of j just inside the steam front

$jF+$ the value of j just outside the steam front

m methane

o oil/hydrocarbon

OB overburden

p phase

r rock/reservoir matrix

t partial derivative with respect to t

w water (liquid)

X the component in the X-direction

Y the component in the Y-direction

θ partial derivative with respect to θ

Superscripts

k iteration level

n time level

1. INTRODUCTION

Numerical simulation is an essential tool in the design and development of oil recovery strategies. It is particularly important for the more costly and marginally economic recovery schemes contemplated for heavy oil and bitumen recovery. One such process is the horizontal-well gravity-drainage process that has recently shown excellent promise in the oil sands of Alberta.

Essentially all steam injection simulators are plagued by two problems. The first problem is most apparent in one-dimensional simulators, which experience spurious oscillations in time, either in the injection pressure or in the injection rate, depending on the boundary conditions imposed. Although less obvious in two- and three-dimensional simulators, the inherent causes of the spurious oscillations are still present. The second problem that is prevalent in numerical simulators is numerical dispersion, which washes out steep gradients and fronts, and leads to significant errors in the prediction of front advance rates.

Both problems can be traced to the large gradients in state variables which exist primarily in the vicinity of steam fronts. These gradients are often so large that they can be reasonably modelled as discontinuities, especially if the equations are to be discretized using the grid spacings which are feasible in conventional simulators. Such discontinuities violate the assumptions from which conventional finite-difference methods are derived.

The steam injection problem is one example of a general class of moving boundary problems, in which a change of phase occurs at a moving boundary. Much research in this area[1,2] has addressed the so-called Stefan problem, which involves conduction heat transfer to a melting surface. Solution methods include: classical analytical solutions for special simple cases; front-tracking methods; and front-fixing methods.

Front-tracking methods are generally based on a finite-difference solution procedure in which the solution domain is broken into an array of stationary grid points at which values of the solution variables are to be computed. The location of the front is then tracked by a line of moving grid points whose velocities are calculated from the governing equations. Alternatively, the entire numerical grid

network is allowed to deform in conformity with the changes in the state variables. Invariably, this sort of approach is based on a variational analysis and finite-element formulation[3].

Front-fixing methods are based on a formal, time-dependent coordinate transformation which maps the moving boundary onto a stationary surface. Once mapped, the stationary boundary problem can be solved using conventional numerical methods such as finite differences. This technique has been used successfully by Duda, Malone, Notter, and Vrentas[4]; by Hsu, Sparrow, and Patankar[5]; and by Sparrow and Hsu[6] for heat conduction with phase change at a single boundary. Saitoh[7] applied the method in a radial coordinate system to handle an arbitrarily shaped boundary.

Unfortunately, most of the published analyses of moving boundary problems have dealt with the Stefan problem, which is elliptic. The non-linear hyperbolic reservoir simulation problem, which is of interest in this work, has received considerably less attention. Furthermore, the extension of these techniques from the Stefan problem to the hyperbolic problem is far from trivial since the treatment of the moving boundary is very dependent on the nature of the governing equations. The analyses of elliptic problems provide little insight for hyperbolic problems.

Another application of moving boundary techniques is to calculate the motion of shock discontinuities in aerodynamic flows[8,9,10]. The equations which describe the flow of a gas are indeed hyperbolic, but are qualitatively different from the reservoir flow equations because a) there is only one phase, the gas phase; b) there is no phase change at the discontinuity; c) no porous medium is present; d) inertial effects are extremely significant; e) the effect of gravity is negligible; f) viscosity is neglected; and g) thermal conduction is neglected. On the other hand, in the steam injection case, a) three fluid phases can be present simultaneously; b) there is a significant phase change, i.e. steam condensation, at the discontinuity; c) a porous material is present; d) inertial effects are negligible; e) the effect of gravity is significant; f) viscosity is significant; and g) thermal conduction is significant. Little insight is provided by the aerodynamics problems.

An application of a boundary-fitted curvilinear coordinate system to the flow of water around a ship is described by Miyata et al.[11]. The boundary to which

they fit their coordinate system is the air-water interface whose shape is not known a priori. Once again, this problem is qualitatively different from our steam chamber problem.

In the 1960's, attempts were made, e.g. by Garder, Peaceman, and Pozzi[12], and by Rachford[13], to use front-tracking to improve the numerical accuracy of solutions to dispersion problems for one-dimensional and two-dimensional single-phase flows in porous media. Garder et al. used a combination of fixed grid points and moving points, whereas Rachford used a combination of a fixed coordinate system and a moving coordinate system. More recently, the status of front-tracking methods (among other topics) for reservoir simulation has been summarized in a collection of articles[14] published by the Society for Industrial and Applied Mathematics. The articles by Colella et al.[15] and by Glimm et al.[16] discuss fixed-grid and variable-grid methods respectively.

Colella et al.[15] describe three methods: Glimm's random choice method, the "Simple Line Interface Calculation" method of Noh and Woodward, and an extension of Godunov's finite-difference scheme. The idea of using a generalization of Godunov's method for reservoir simulation has been developed further by Bell and Shubin[18]. These three methods are all fixed-grid methods, and their front-tracking capability may be attributed to the modified finite-difference formulae which are used. Fixed-grid methods have the advantage that they are general-purpose with regard to the geometry of the problem, but have the disadvantage that it is difficult or impossible to incorporate a refined mesh near the front. In contrast, the front-fixing methods mentioned previously readily allow a refined mesh near the front, but are rather problem-specific since the required transformations rely on problem-dependent assumptions regarding the shape of the moving boundary.

Glimm et al.[16] describe a variable-grid method which aligns the two-dimensional computational grid to the saturation front so that the grid is rectangular away from the front and has irregular quadrilaterals only in the immediate vicinity of the front. Their method allows separate mesh refinements in the two coordinate directions, but this is of limited use if the front extends diagonally across the grid, and one desires mesh refinement mainly in the vicinity of the front.

Douglas et al.[19] describe a finite-element method which uses dynamic mesh modification "two or three times per problem" to provide finer discretization near the front than farther away from the front. Their mesh modification method is simpler than the method of Glimm et al., and has the same disadvantage when the front extends diagonally across the grid.

Another class of variable-grid methods is the class of moving finite element methods. Unlike the methods of Glimm et al.[16] and of Douglas et al.[19], in which the mesh changes only when it is redrawn via a mesh generation algorithm, the moving finite element methods allow the mesh to be deformed gradually, according to the pattern of fluid flow. Carey et al.[20] have reviewed this class of methods, and propose to introduce a coordinate transformation in order to improve the behaviour of their approximate solution near the front. However, the moving finite element methods have the disadvantage, in general, that the grid points can move too close together, and the mesh can become tangled. The coordinate transformation method proposed by Carey et al. does not resolve this problem. Therefore, to resolve this problem, Carey et al. propose two possible modifications (either remove grid points during the course of the simulation or introduce artificial penalty functions to keep the grid points apart), but have not demonstrated that either modification is satisfactory.

A moving coordinate system technique for tracking sharp fronts has been proposed by Jensen and Finlayson[21]. The basic idea of their method is very similar to what we have done, namely, to transform the differential equations into a time-dependent coordinate system in which the front is stationary (or at least does not move much), and almost everything else is moving. However, their coordinate transformation is less general than our coordinate transformation. For two-dimensional simulations, Jensen and Finlayson use a coordinate system in which one point of the front is stationary, while the rest of the front can drift, whereas we use a coordinate system in which the entire front is stationary. Another difference between the two methods is that Jensen and Finlayson do not use any matching conditions, such as our equation (2.5). Indeed, it is quite difficult to incorporate matching conditions into a simulator unless the entire front is stationary.

In addition to fixed-grid and variable-grid methods, a third possibility is no-grid. Such a method has been proposed by Karp and Greenstadt[22]. Their method consists of calculating the best approximation from a class of functions with no discontinuities; this class of functions is carefully constructed so that (a) some of its members resemble closely the solutions with sharp fronts which one expects from reservoir simulation problems, and (b) the task of computing the best approximation from this class is (theoretically) not computationally intensive. However, they admit that the application of their method to the quarter 5-spot problem of oil reservoir modelling was a "tour de force", and they recommend that for more complicated problems, some spatial discretization should be used.

All the articles described in the preceding seven paragraphs confine their discussion to isothermal two-phase flow. The equations describing steam flow in a reservoir are considerably more complicated than the equations describing isothermal two-phase flow, and, to the best of our knowledge, no extension to steam flow simulation of any of the above methods has been reported.

As the first step[23] in our work to develop a moving boundary technique useful for studying the development of a steam chamber, a front-tracking simulator was developed to track the steam front and solve explicitly for the state variables at the front, for a one-dimensional steam flood. In that simulator, an additional, moving grid point was incorporated into the finite-difference system, to track the location of the steam front, as it advanced through the stationary grid system. The simulator was able to reduce substantially the magnitude of injection rate/pressure oscillations, and to reduce the numerical dispersion.

Based on the success in one dimension, this work was extended to two dimensions[24] by introducing an array of front-tracking grid points into a two-dimensional simulator to track the location of the steam front. However, this approach turned out to be extremely complex in two dimensions and the simulator experienced considerable problems in converging to the solution. Furthermore, although this approach had the potential to resolve the problem of flow rate/pressure oscillations in the two-dimensional case, it was apparent that it could not resolve the numerical dispersion problem due to the complex, coarse grid network, in the vicinity of the steam front, which was required for the numerical solution.

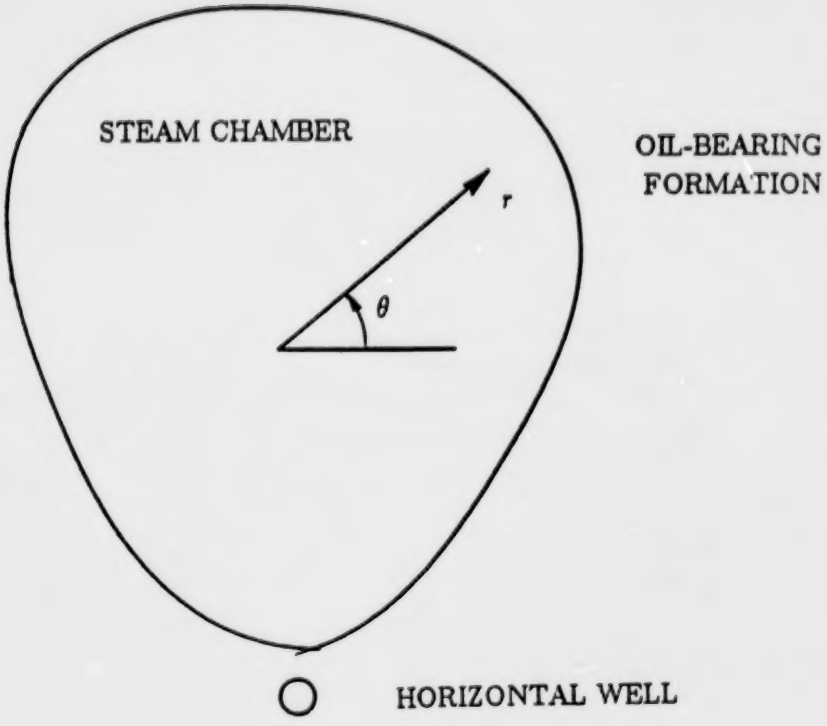

FIGURE 1.1 - A vertical cross-section through the steam chamber, orthogonal to the horizontal well.

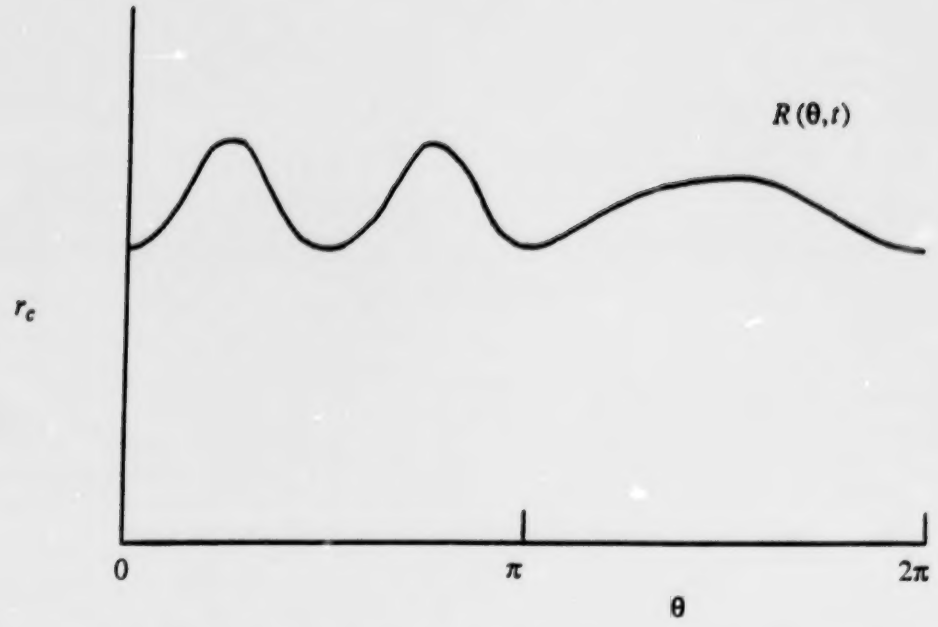

FIGURE 1.2 a) - Front location in the cylindrical coordinate system.

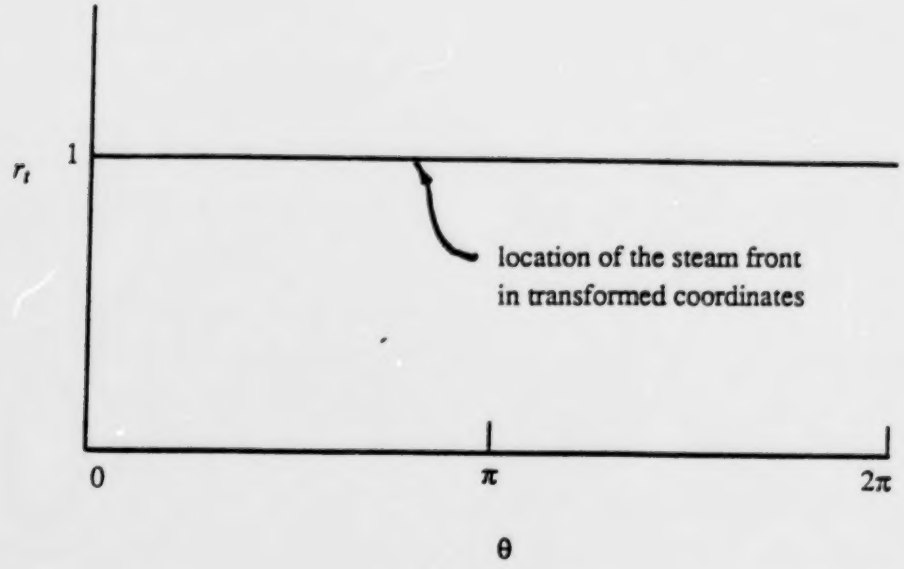

FIGURE 1.2 b) - Front location in the transformed coordinate system.

Ideally, to minimize the numerical dispersion associated with a numerical simulator, not only is it necessary to locate explicitly the steam front, but also a fine mesh is required in the vicinity of the steam front where large gradients in the solution variables occur. This fine mesh is difficult to achieve even with front-tracking. One possible approach is to incorporate, in the immediate vicinity of the front, an associated refined grid network which moves with the front. This approach is expected to have many operational problems. Instead, in the present work, we have pursued a front-fixing approach which mathematically maps the moving steam front onto a stationary surface. Once this is accomplished, it is simple to impose a refined grid system in the vicinity of the stationary surface in the transformed coordinate system. Although the present work is confined to two dimensions, it is intended that the method be extended to three dimensions in a subsequent phase of the work.

The transformation to be used is somewhat problem-specific. In view of the significance of the horizontal-well process, we will confine our discussion and development to the horizontal-well geometry. Figure 1.1 shows a vertical cross-section through the steam chamber, orthogonal to the horizontal well, at some time during the recovery operation. Oil is being produced through the horizontal well and steam is being injected through some other well into the chamber. Superimposed on this cross-section is a cylindrical (r_c,θ) coordinate system.

To map the chamber boundary, which is also the steam front, onto a stationary boundary, we apply the transformation, similar to that of Saitoh[7],

$$r_t = \frac{r_c}{R(\theta,t)} \tag{1.1}$$

where $R(\theta,t)$ is the radial distance from the centre of the (r_c,θ) coordinate system to the steam chamber boundary for a particular θ, at time t. In the new (r_t,θ) coordinate system, the non-circular moving boundary of the steam chamber is mapped onto a stationary circular surface of radius 1.0. The transformation is schematically represented in figure 1.2.

If the solution for temperature, saturation, pressure, etc. is computed in the (r_t,θ) coordinate system, it can easily be transformed back to the original (r_c,θ) frame of reference. In the (r_t,θ) coordinate system, it is also clearly possible to

implement a refined numerical solution mesh in the vicinity of $r_t=1$.

In the following, the theoretical background for the transformed-grid approach will be developed. The governing equations will be transformed into the time-dependent frame of reference, and the matching conditions relevant at the steam front will be derived.

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2. THE GOVERNING EQUATIONS

The standard method for deriving fluid flow equations is to calculate material and enthalpy balances on a small control volume in the reservoir. We distinguish two cases: either the control volume contains the steam front, or it does not. If the control volume does not contain the steam front, then the material and enthalpy balances imply a set of fluid transport equations. These equations are listed in section 2.1 of this report. If the control volume does contain the steam front, then the material and enthalpy balances imply a set of matching conditions, valid for the interface between the steam zone and the steamless zone. These matching conditions are derived in section 2.2.

2.1 The Transport Equations

If a material balance on component c in phase p is performed on a small stationary control volume which does not contain the steam front, the resulting equation is

$$\frac{\partial}{\partial t}(\phi S_p \rho_p w_{pc}) - \sigma_p M_c - q_{pc}$$

$$= -\nabla\cdot(-\tau_p w_{pc} \nabla\Phi_p) - \nabla\cdot(-\mathbf{D}_{pc} \nabla w_{pc}) \quad , \quad p = g, o, w \quad , \quad c = 1,2,3 \qquad (2.1)$$

If an enthalpy balance is performed on this control volume, the resulting equation is

$$\frac{\partial}{\partial t}(\textstyle\sum_p \phi S_p \rho_p h_p + (1-\phi)\rho_r h_r) - \sum_p h_p q_p$$

$$= -\nabla\cdot(-\textstyle\sum_p \tau_p h_p \nabla\Phi_p) - \nabla\cdot(-\sum_{pc} \mathbf{D}_{pc} h_{pc} \nabla w_{pc}) - \nabla\cdot(-k_T \nabla T) \qquad (2.2)$$

Equations more or less similar to (2.1) and (2.2) appear almost universally in the reservoir simulation literature; therefore, it is superfluous to include a derivation here. The most significant difference between equations (2.1) and (2.2), and the equations which other researchers use is the presence of the diffusion terms, i.e. the terms containing $\mathbf{D}_{pc}$, in order to account for vapour-phase diffusion, which is thought to be significant in the horizontal-well process which we are simulating.

2.2 The Matching Conditions

Matching conditions for the interface between the region with vapour and the region without vapour can be derived via material and enthalpy balances on a small stationary control volume which contains the interface. In a previous report[1], this method was used to derive a matching condition for axial heat conduction through two bars of different thermal conductivity attached end-to-end, and was then used to derive matching conditions for a one-dimensional model of an oil sands reservoir. In this section of this report, matching conditions are derived for a two-dimensional model of an oil sands reservoir.

Consider a section of a reservoir shown in figure 2.1 into which steam is being injected. The variables of interest are assumed to be a function of X and Y, but not of Z. Suppose that the steam front may be modelled as a sharp interface between the two regions, and that this interface is a smooth curve with no sharp corners. Then, for a sufficiently small control volume, this interface, in turn, may be modelled as a plane separating the two regions, as in figure 2.2, where $\underline{n}$ is the unit vector normal to the interface, and $\underline{s}$ is a unit vector tangent to the interface.

The phase saturations and compositions can be assumed to be differentiable functions of X and Y, except at the interface, where they may be discontinuous. In addition, it is reasonable to assume that the pressure and temperature are continuous and continuously differentiable functions of X and Y, except at the interface, where their derivatives may be discontinuous.

For the purpose of deriving matching conditions for this moving interface problem, a small *stationary* control volume is constructed around the interface as in figures 2.2 and 2.3. As figure 2.2 shows, the axes of the control volume are parallel respectively with the Z axis, with the vector $\underline{n}$ normal to the interface, and with the vector $\underline{s}$ tangential to the intersection of the interface with the X, Y plane. As figure 2.3 shows, the control volume is large enough that the interface is always inside the control volume during a period of duration δt.

The balance for component c consists basically of an accounting of all flows of the component in and out of the control volume during the time interval δt. The net flow into the control volume is accounted for as a "change" in the contents of

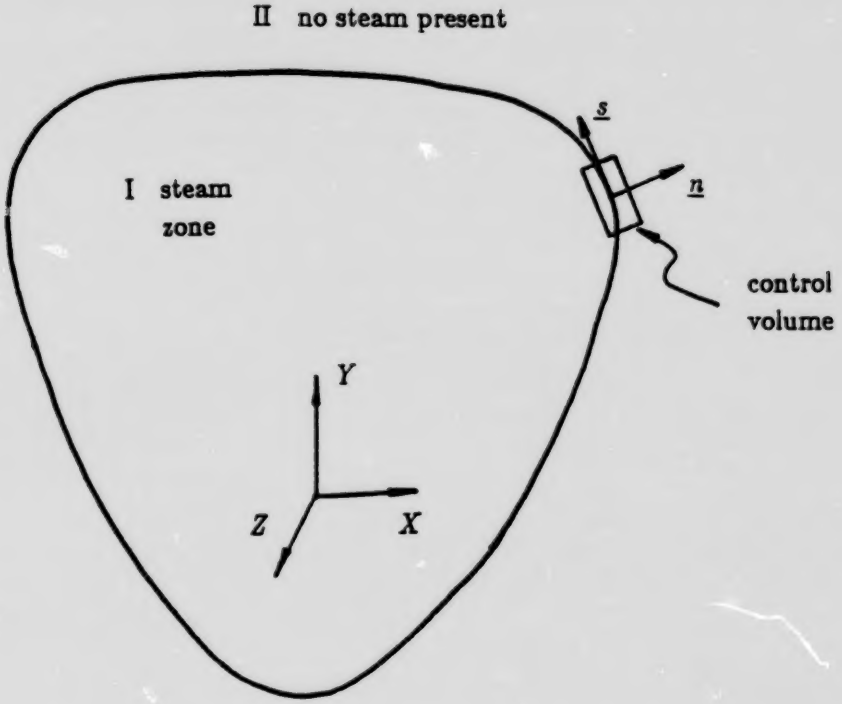


FIGURE 2.1 - Location of the control volume used to derive the matching conditions.

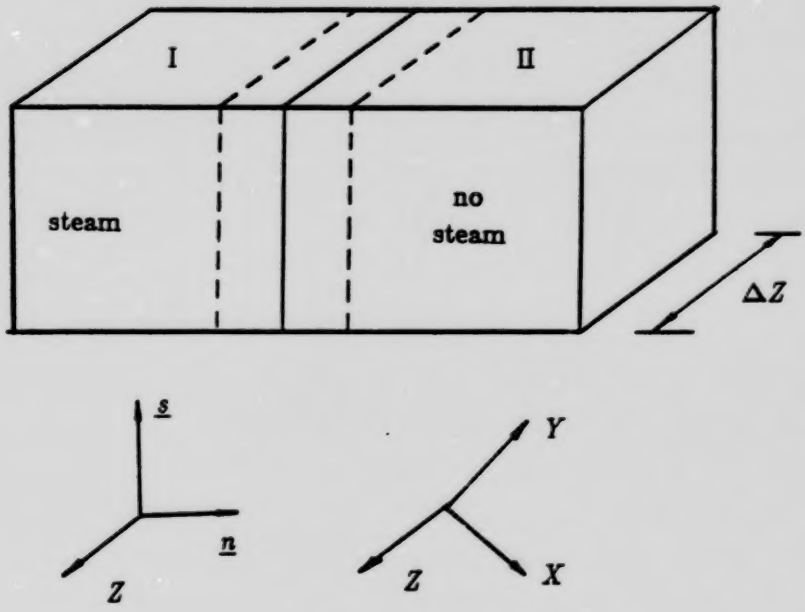


FIGURE 2.2 - The control volume used to derive matching conditions.

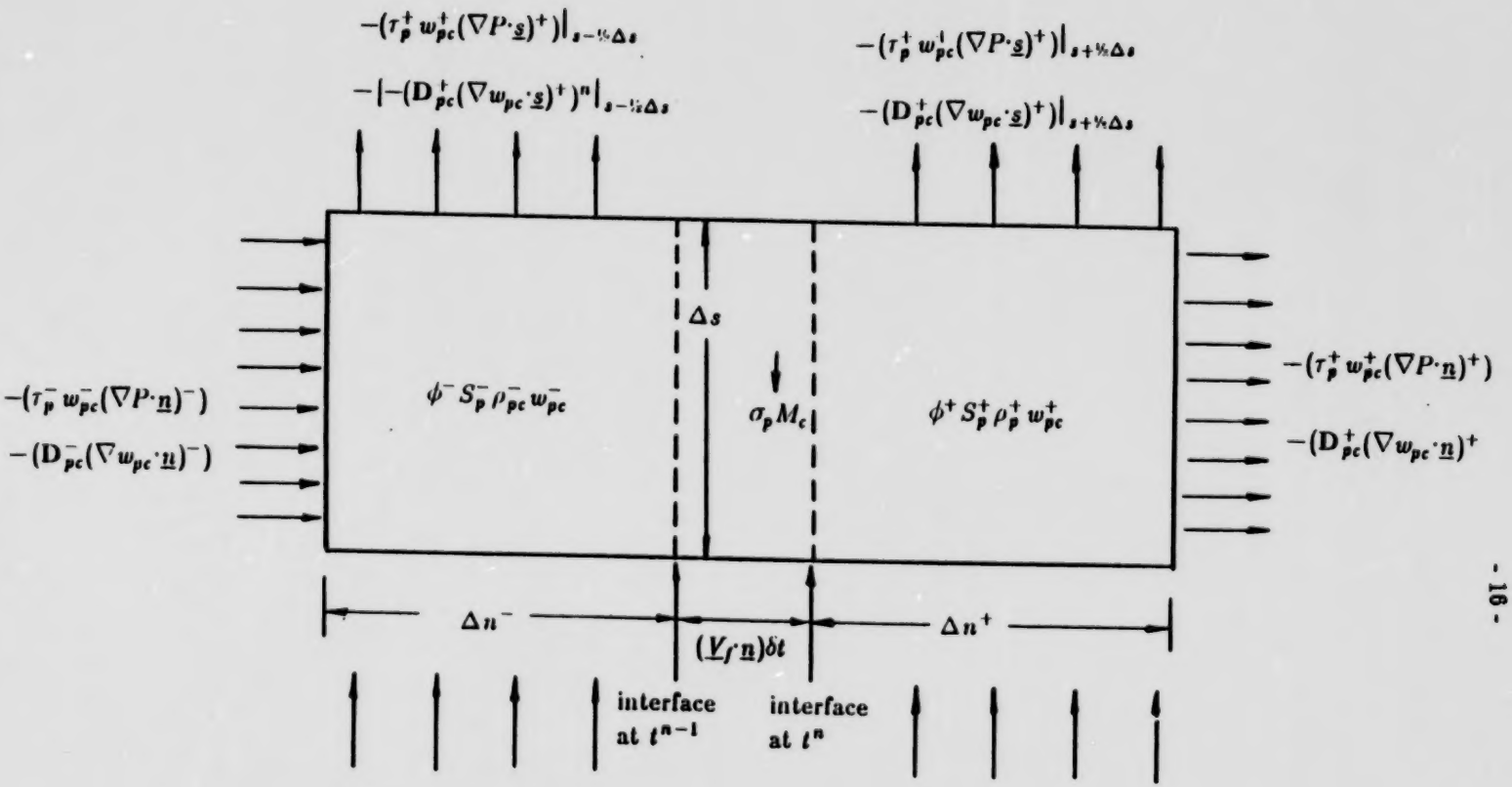


FIGURE 2.3 - Material balance on the control volume of figure 2.2 .

Table 2.1 - Material Balance on Species c in Phase p

$$(\phi^- S_p^- \rho_{pc}^- w_{pc}^-)^n \Delta s \Delta Z (\Delta n^- + (\underline{V}_f \cdot \underline{n})\delta t) + (\phi^+ S_p^+ \rho_p^+ w_{pc}^+)^n \Delta s \Delta Z \Delta n^+$$

amount of component c in phase p at t^n
(see note 1)

$$-(\phi^- S_p^- \rho_p^- w_{pc}^-)^{n-1} \Delta s \Delta Z \Delta n^- - (\phi^+ S_p^+ \rho_p^+ w_{pc}^+)^{n-1} \Delta s \Delta Z (\Delta n^+ + (\underline{V}_f \cdot \underline{n})\delta t)$$

amount of component c in phase p at t^{n-1}

$$+ o((\Delta s(\Delta n^- + (\underline{V}_f \cdot \underline{n})\delta t) + \Delta n^+))\Delta Z$$

order of the error (see note 2)

$$= -(\tau_p^- w_{pc}^- (\nabla P \cdot \underline{n})^-)^n \Delta s \Delta Z \delta t + (\tau_p^+ w_{pc}^+ (\nabla P \cdot \underline{n})^+)^n \Delta s \Delta Z \delta t$$

advection in the normal direction

$$+ \left| -(\tau_p^- w_{pc}^- (\nabla P \cdot \underline{s})^-)^n \right|_{s - \frac{1}{2}\Delta s} + (\tau_p^- w_{pc}^- (\nabla P \cdot \underline{s})^-)^n \Big|_{s + \frac{1}{2}\Delta s} \Big| (\Delta n^- + \tfrac{1}{2}(\underline{V}_f \cdot \underline{n})\delta t) \Delta Z \delta t$$

advection in the tangential direction on the
negative side of the interface

$$+ \left| -(\tau_p^+ w_{pc}^+ (\nabla P \cdot \underline{s})^+)^n \right|_{s - \frac{1}{2}\Delta s} + (\tau_p^+ w_{pc}^+ (\nabla P \cdot \underline{s})^+)^n \Big|_{s + \frac{1}{2}\Delta s} \Big| (\Delta n^+ + \tfrac{1}{2}(\underline{V}_f \cdot \underline{n})\delta t) \Delta Z \delta t$$

advection in the tangential direction on the
positive side of the interface

$$-(\mathbf{D}_{pc}^- (\nabla w_{pc} \cdot \underline{n})^-)^n \Delta s \Delta Z \delta t + (\mathbf{D}_{pc}^+ (\nabla w_{pc} \cdot \underline{n})^+)^n \Delta s \Delta Z \delta t$$

diffusion in the normal direction

$$+ \left| -(\mathbf{D}_{pc}^- (\nabla w_{pc} \cdot \underline{s})^-)^n \right|_{s - \frac{1}{2}\Delta s} + (\mathbf{D}_{pc}^- (\nabla w_{pc} \cdot \underline{s})^-)^n \Big|_{s + \frac{1}{2}\Delta s} \Big| (\Delta n^- + \tfrac{1}{2}(\underline{V}_f \cdot \underline{n})\delta t) \Delta Z \delta t$$

diffusion in the tangential direction on the
negative side of the interface

$$+[-(\mathbf{D}^{+}_{pc}(\nabla w_{pc}\cdot\underline{s})^{+})^{n}|_{s-\frac{1}{2}\Delta s}+(\mathbf{D}^{+}_{pc}(\nabla w_{pc}\cdot\underline{s})^{+})^{n}|_{s+\frac{1}{2}\Delta s}](\Delta n^{+}+\tfrac{1}{2}(\underline{V}_{f}\cdot\underline{n})\delta t)\Delta Z\delta t$$

diffusion in the tangential direction on the positive side of the interface

$$+\sigma_{p}M^{n}_{c}\Delta s\Delta Z(\Delta n^{-}+(\underline{V}_{f}\cdot\underline{n})\delta t+\Delta n^{+})\delta t$$

gain by the phase due to condensation

$$+o(\Delta s\delta t)\Delta Z+o(\Delta s(\Delta n^{-}+(\underline{V}_{f}\cdot\underline{n})\delta t+\Delta n^{+}))\Delta Z \qquad (2.3)$$

order of the error

---

1. n used as superscript denotes time level, n used elsewhere refers to the normal direction.
2. See the note on the little "o" notation in the nomenclature section.

the control volume. Using the nomenclature defined in the Nomenclature section and in figure 2.3, we have constructed the material balance for component c in phase p, which is given in table 2.1 as equation (2.3). Let the following manipulations be applied to equation (2.3): (1) the equation is divided by $\Delta s \Delta Z \delta t$; (2) the time-level differences on the left side of the equation are replaced by partial derivatives with respect to t, plus $o(\delta t)$ terms; and (3) the differences in the terms for advection and diffusion in the tangential direction are replaced by partial derivatives with respect to s, plus $o(\Delta s)$ terms. Then, the equation which results is

$$\left[\frac{\partial(\phi^- S_p^- \rho_p^- w_{pc}^-)}{\partial t}\right]^n \Delta n^- + \left[\frac{\partial(\phi^+ S_p^+ \rho_p^+ w_{pc}^+)}{\partial t}\right]^n (\Delta n^+ + (\underline{V}_f \cdot \underline{n})\delta t)$$

$$+ |(\phi^- S_p^- \rho_p^- w_{pc}^-)^n - (\phi^+ S_p^+ \rho_p^+ w_{pc}^+)^n| (\underline{V}_f \cdot \underline{n})$$

$$= -(\tau_p^- w_{pc}^- (\nabla P \cdot \underline{n})^-)^n + (\tau_p^+ w_{pc}^+ (\nabla P \cdot \underline{n})^+)^n$$

$$+ \left[\frac{\partial(\tau_p^- w_{pc}^- (\nabla P \cdot \underline{s})^-)}{\partial s}\right]^n \Bigg|_s |\Delta n^- + \tfrac{1}{2}(\underline{V}_f \cdot \underline{n})\delta t|$$

$$+ \left[\frac{\partial(\tau_p^+ w_{pc}^+ (\nabla P \cdot \underline{s})^+)}{\partial s}\right]^n \Bigg|_s |\Delta n^+ + \tfrac{1}{2}(\underline{V}_f \cdot \underline{n})\delta t|$$

$$- (\mathbf{D}_{pc}^- (\nabla w_{pc} \cdot \underline{n})^-)^n + (\mathbf{D}_{pc}^+ (\nabla w_{pc} \cdot \underline{n})^+)^n$$

$$+ \left[\frac{\partial(\mathbf{D}_{pc}^- (\nabla w_{pc} \cdot \underline{s})^-)}{\partial s}\right]^n \Bigg|_s |\Delta n^- + \tfrac{1}{2}(\underline{V}_f \cdot \underline{n})\delta t|$$

$$+ \left[\frac{\partial(\mathbf{D}_{pc}^+ (\nabla w_{pc} \cdot \underline{s})^+)}{\partial s}\right]^n \Bigg|_s |\Delta n^+ + \tfrac{1}{2}(\underline{V}_f \cdot \underline{n})\delta t|$$

$$+ \sigma_p M_c^n (\Delta n^- + (\underline{V}_f \cdot \underline{n})\delta t + \Delta n^+)$$

$$+ o\left(\frac{\Delta n^-}{\delta t} + \underline{V}_f \cdot \underline{n} + \frac{\Delta n^+}{\delta t}\right) + o(1) \qquad (2.4)$$

Finally, we can take the limit of this equation as Δn^-, Δn^+, and Δs go to zero, and subsequently as δt goes to zero. The condensation term, however, requires some special consideration since, at the steam front, intense condensation

(or evaporation) will be taking place. This condensation may be represented as a line source at the interface. Hence, even in the limit $\Delta n^+ \rightarrow 0$, $\Delta n^- \rightarrow 0$, $\Delta s \rightarrow 0$, and $\delta t \rightarrow 0$, the condensation term will remain finite. We use the notation $\overline{M}_c$ to denote the strength of the line-source condensation, to distinguish it from the diffuse condensation M_c. Thus, the matching condition becomes (with the superfluous superscript n omitted)

$$(\phi^- S_p^- \rho_p^- w_{pc}^- - \phi^+ S_p^+ \rho_p^+ w_{pc}^+)(\underline{V}_f \cdot \underline{n})$$
$$= -\tau_p^- w_{pc}^- (\nabla P \cdot \underline{n})^- + \tau_p^+ w_{pc}^+ (\nabla P \cdot \underline{n})^+$$
$$-\mathbf{D}_{pc}^- (\nabla w_{pc} \cdot \underline{n})^- + \mathbf{D}_{pc}^+ (\nabla w_{pc} \cdot \underline{n})^+ + \sigma_p \overline{M}_c \quad , \quad c = 1, \ldots, N_c + 1 \tag{2.5}$$

Note that the gradient components $\nabla P \cdot \underline{s}$ and $\nabla w_{pc} \cdot \underline{s}$ do not show up in the matching conditions.

The derivation of the enthalpy matching condition parallels the derivation of the material matching conditions. A small stationary control volume is constructed around the interface, oriented the same way as for the derivation of the material matching conditions, as in figure 2.2, and large enough that the interface is always inside the control volume during the period of duration δt, as in figure 2.3. An enthalpy balance is performed on this control volume.

After considerable manipulation, the enthalpy matching condition becomes

$$(\phi^- \sum_p S_p^- \rho_p^- h_p^- - \phi^+ \sum_p S_p^+ \rho_p^+ h_p^+)(\underline{V}_f \cdot \underline{n}) + [(1-\phi^-)\rho_r^- h_r^- - (1-\phi^+)\rho_r^+ h_r^+](\underline{V}_f \cdot \underline{n})$$
$$= -\sum_p \tau_p^- h_p^- (\nabla P \cdot \underline{n})^- + \sum_p \tau_p^+ h_p^+ (\nabla P \cdot \underline{n})$$
$$-\sum_{p,c} \mathbf{D}_{pc}^- h_{pc}^- (\nabla w_{pc} \cdot \underline{n})^- + \sum_{p,c} \mathbf{D}_{pc}^+ h_{pc}^+ (\nabla w_{pc} \cdot \underline{n})^+$$
$$-k_T^- (\nabla T \cdot \underline{n})^- + k_T^+ (\nabla T \cdot \underline{n})^+ \tag{2.6}$$

Reference for Chapter 2

1. P.G. de Buda and D.E. Cormack, "*Numerical Simulation of Steam Injection in Bitumen and Heavy Oil Reservoirs*", *Phase I: Part 1*, 1984, contract report prepared for the Department of Energy, Mines and Resources, Canada.

3. THE COORDINATE TRANSFORMATION

The coordinate transformation which is used in the simulator to track the location of the steam front is described by the equations:

$$\left.\begin{aligned} X(r,\theta,t) &= rR(\theta,t)\cos\theta \\ Y(r,\theta,t) &= rR(\theta,t)\sin\theta + b(t) \end{aligned}\right\} \tag{3.01}$$

Basically, this is a generalized polar coordinate system with a moving centre whose motion along the y-axis is described by the function $b(t)$. Unlike the usual polar coordinate system, the radial direction is represented not by r, but by the product $rR(\theta,t)$, where $R(\theta,t)$ represents the distance of the steam front from the moving centre of the coordinate system, and r is a dimensionless radial coordinate, which equals 1 at the steam front, and equals 0 at the centre of the coordinate system. The function $R(\theta,t)$ is clearly unknown a priori, and is solved for, by the simulator, simultaneously with the other unknowns, e.g. pressure, temperature, etc.

The purpose of the function $b(t)$ in (3.01) is to ensure that the moving centre is always located well inside the steam zone. Since this condition is a relatively mild constraint, it is not difficult to select a $b(t)$ which satisfies this condition. Therefore, $b(t)$ may be regarded as a known function. Currently, in the simulator, $b(t)$ is set to 0, but $b(t)$ could also be set to perhaps $10^{-6}t$, if the steam chamber drifts upwards.

The coordinate transformation (3.01) has the following basic properties

$$\left.\begin{aligned} \frac{\partial X}{\partial r} &= R(\theta,t)\cos\theta \qquad \frac{\partial X}{\partial \theta} = r\left[R_\theta(\theta,t)\cos\theta - R(\theta,t)\sin\theta\right] \\ \frac{\partial Y}{\partial r} &= R(\theta,t)\sin\theta \qquad \frac{\partial Y}{\partial \theta} = r\left[R_\theta(\theta,t)\sin\theta + R(\theta,t)\cos\theta\right] \end{aligned}\right\} \tag{3.02}$$

and

$$J(X,Y;r,\theta) \equiv \begin{vmatrix} \dfrac{\partial X}{\partial r} & \dfrac{\partial X}{\partial \theta} \\ \dfrac{\partial Y}{\partial r} & \dfrac{\partial Y}{\partial \theta} \end{vmatrix} = rR(\theta,t)^2 \equiv J(r,\theta,t) \tag{3.03}$$

3.1 The Transformation of the Transport Equations

Because the coordinate transformation (3.01) is a function of time, the time-derivative terms in the transport equations (2.1) and (2.2) are affected. In equation (2.1), it is understood that the time-derivative term $\frac{\partial}{\partial t}(\phi S_p \rho_p w_{pc})$ is the derivative of $(\phi S_p \rho_p w_{pc})$ with respect to time, when X and Y are held constant. In the present context, in which r and θ are also independent variables, it is useful to denote this derivative by

$$\left(\frac{\partial(\phi S_p \rho_p w_{pc})}{\partial t}\right)_{X,Y}$$

where the subscripts X and Y indicate that X and Y are held constant, while r and θ need not be held constant. (This notation is standard in thermodynamics textbooks.) On the other hand, it is desirable that the time derivatives in the transformed equations can be interpreted as derivatives with respect to time when r and θ are held constant, while X and Y need not be held constant, i.e. as derivatives of the form $\left(\frac{\partial(-)}{\partial t}\right)_{r,\theta}$. Because of the dynamic coupling among X, Y, r, θ and t, it cannot be assumed that $\left(\frac{\partial}{\partial t}\right)_{X,Y}$ equals $\left(\frac{\partial}{\partial t}\right)_{r,\theta}$ in general. Thus, the equations (3.01) should be regarded not as a 2x2 transformation from the X, Y coordinate system to the r, θ coordinate system, but as a 3x3 transformation from the X, Y, t coordinate system to the r, θ, t coordinate system.

The coordinate transformation can be developed using the basic principles of the calculus of several variables. Let u be any arbitrary function of the dependent variables pressure, temperature, etc. Since pressure, temperature, etc. depend on X, Y, and t, so does u. Starting with the fundamental identity

$$du = \left(\frac{\partial u}{\partial X}\right)_{Y,t} dX + \left(\frac{\partial u}{\partial Y}\right)_{X,t} dY + \left(\frac{\partial u}{\partial t}\right)_{X,Y} dt \qquad (3.04)$$

and taking the partial derivative of (3.04) successively with respect to r, θ, and t, one can derive the following system

$$\begin{bmatrix} \left(\frac{\partial u}{\partial r}\right)_{\theta,t} \\ \left(\frac{\partial u}{\partial \theta}\right)_{r,t} \\ \left(\frac{\partial u}{\partial t}\right)_{r,\theta} \end{bmatrix} = \begin{bmatrix} \left(\frac{\partial X}{\partial r}\right)_{\theta,t} & \left(\frac{\partial Y}{\partial r}\right)_{\theta,t} & 0 \\ \left(\frac{\partial X}{\partial \theta}\right)_{r,t} & \left(\frac{\partial Y}{\partial \theta}\right)_{r,t} & 0 \\ \left(\frac{\partial X}{\partial t}\right)_{r,\theta} & \left(\frac{\partial Y}{\partial t}\right)_{r,\theta} & 1 \end{bmatrix} \begin{bmatrix} \left(\frac{\partial u}{\partial X}\right)_{Y,t} \\ \left(\frac{\partial u}{\partial Y}\right)_{X,t} \\ \left(\frac{\partial u}{\partial t}\right)_{X,Y} \end{bmatrix} \tag{3.05}$$

In (3.05), the derivatives all have subscripts indicating which variables are to be held constant. These subscripts are necessary for the partial derivatives with respect to t, since these derivatives could be calculated either holding X and Y constant, or holding r and θ constant. On the other hand, for the other partial derivatives, these subscripts are redundant, since it is obvious in each case which variables are to be held constant. Thus, these subscripts are (usually) omitted from the equations in this report. Using standard linear algebra, the system (3.05) can be inverted to obtain (omitting the redundant subscripts)

$$\begin{bmatrix} \frac{\partial u}{\partial X} \\ \frac{\partial u}{\partial Y} \\ \left(\frac{\partial u}{\partial t}\right)_{X,Y} \end{bmatrix} = \begin{bmatrix} \frac{1}{J(r,\theta,t)}\frac{\partial Y}{\partial \theta} & \frac{-1}{J(r,\theta,t)}\frac{\partial Y}{\partial r} & 0 \\ \frac{-1}{J(r,\theta,t)}\frac{\partial X}{\partial \theta} & \frac{1}{J(r,\theta,t)}\frac{\partial X}{\partial r} & 0 \\ \frac{J_3(r,\theta,t)}{J(r,\theta,t)} & \frac{-J_2(r,\theta,t)}{J(r,\theta,t)} & 1 \end{bmatrix} \begin{bmatrix} \frac{\partial u}{\partial r} \\ \frac{\partial u}{\partial \theta} \\ \left(\frac{\partial u}{\partial t}\right)_{r,\theta} \end{bmatrix} \tag{3.06}$$

where $J(r,\theta,t)$ is given in equation (3.03), and $J_2(r,\theta,t)$ and $J_3(r,\theta,t)$ are given in equations (3.07) and (3.08):

$$J_2(r,\theta,t) = \frac{\partial X}{\partial r}\left(\frac{\partial Y}{\partial t}\right)_{r,\theta} - \frac{\partial Y}{\partial r}\left(\frac{\partial X}{\partial t}\right)_{r,\theta} \tag{3.07}$$

$$J_3(r,\theta,t) = \frac{\partial X}{\partial \theta}\left(\frac{\partial Y}{\partial t}\right)_{r,\theta} - \frac{\partial Y}{\partial \theta}\left(\frac{\partial X}{\partial t}\right)_{r,\theta} \tag{3.08}$$

In equations (3.04) through (3.06), the variable t has been handled as just another independent variable, like X, Y, r, and θ. However, it clearly behaves differently from the other independent variables, as the third columns of the matrices in (3.05) and (3.06) show. Thus, separate discussions of the time-derivatives terms and of the flow terms in equations (2.1) and (2.2) are justified.

3.1.1 The Time-Derivative Terms

The equations describing the transformation of the time-derivatives in equations (2.1) and (2.2) may be obtained from the third row of the system (3.06). Let R_t and R_θ denote the partial derivatives of R:

$$R_t(\theta,t) \equiv \left[\frac{\partial R(\theta,t)}{\partial t}\right]_\theta \quad , \quad R_\theta(\theta,t) \equiv \left[\frac{\partial R(\theta,t)}{\partial \theta}\right]_t$$

Then, substitution of (3.01) into (3.07) and (3.08) yields

$$J_2(r,\theta,t) = R(\theta,t)\cos\theta \left[\frac{db(t)}{dt}\right] \tag{3.09}$$

$$J_3(r,\theta,t) = -r^2 R(\theta,t)R_t(\theta,t) - r(R(\theta,t)\sin\theta - R_\theta(\theta,t)\cos\theta)\left[\frac{db(t)}{dt}\right] \tag{3.10}$$

It is convenient, at this point, to introduce the differential operator D_t, defined by (3.13), to summarize the result of transforming the time derivatives. Thus, equations (3.09), (3.10), and (3.03) may be used together with the third row of (3.06) to derive the transformed version of the time-derivatives in equations (2.1) and (2.2)

$$\left[\frac{\partial(\phi S_p \rho_p w_{pc})}{\partial t}\right]_{X,Y} = D_t(\phi S_p \rho_p w_{pc}) \tag{3.11}$$

and

$$\left[\frac{\partial[\Sigma_p \phi S_p \rho_p h_p + (1-\phi)\rho_r h_r]}{\partial t}\right]_{X,Y} = D_t(\Sigma_p \phi S_p \rho_p h_p + (1-\phi)\rho_r h_r) \tag{3.12}$$

where

$$D_t \equiv \frac{\partial}{\partial t} - \frac{\cos\theta}{rR(\theta,t)}\left[\frac{db(t)}{dt}\right]\frac{\partial}{\partial \theta} - \frac{1}{R(\theta,t)}\left\{rR_t(\theta,t) + \left[\frac{R(\theta,t)\sin\theta - R_\theta(\theta,t)\cos\theta}{R(\theta,t)}\right]\left[\frac{db(t)}{dt}\right]\right\}\frac{\partial}{\partial r} \tag{3.13}$$

3.1.2 The Flow Terms

The first two rows of the system (3.06) can be used to calculate how the flow terms $-\nabla\cdot(-\tau_p w_{pc}\nabla\Phi_p)$, $-\nabla\cdot(-\mathbf{D}_{pc}\nabla w_{pc})$, $-\nabla\cdot(-\Sigma_p\tau_p h_p\nabla\Phi_p)$, $-\nabla\cdot(-\Sigma_{pc}\mathbf{D}_{pc}h_{pc}\nabla w_{pc})$ and $-\nabla\cdot(-k_T\nabla T)$ in (2.1) and (2.2) transform. It is convenient here to define the differential operators D^X and D^Y by

$$D^X\equiv-\frac{\partial X}{\partial\theta}\frac{\partial}{\partial r}+\frac{\partial X}{\partial r}\frac{\partial}{\partial\theta}\qquad D^Y\equiv\frac{\partial Y}{\partial\theta}\frac{\partial}{\partial r}-\frac{\partial Y}{\partial r}\frac{\partial}{\partial\theta}\tag{3.14}$$

The first two rows of (3.06) can then be rewritten as

$$\frac{\partial u}{\partial X}=\frac{1}{J}D^Y u\qquad\frac{\partial u}{\partial Y}=\frac{1}{J}D^X u\tag{3.15}$$

Equations (3.15) can then be used to transform the flow terms of (2.1) and (2.2)

$$\begin{aligned}-\nabla\cdot(-\tau_p w_{pc}\nabla\Phi_p)-\nabla\cdot(-\mathbf{D}_{pc}\nabla w_{pc})&\\ =\frac{1}{J}\Big\{&D^X(\tau_p w_{pc}\frac{1}{J}D^X\Phi)+D^Y(\tau_p w_{pc}\frac{1}{J}D^Y\Phi)\\ &+D^X(\mathbf{D}_{pc}\frac{1}{J}D^X w_{pc})+D^Y(\mathbf{D}_{pc}\frac{1}{J}D^Y w_{pc})\Big\}\end{aligned}\tag{3.16}$$

and

$$\begin{aligned}-\nabla\cdot(-\Sigma_p\tau_p h_p\nabla\Phi_p)-\nabla\cdot(-\Sigma_{pc}\mathbf{D}_{pc}h_{pc}\nabla w_{pc})-\nabla\cdot(-k_T\nabla T)&\\ =\frac{1}{J}\Big\{&D^X(\Sigma_p\tau_p h_p\frac{1}{J}D^X\Phi_p)+D^Y(\Sigma_p\tau_p h_p\frac{1}{J}D^Y\Phi_p)\\ &+D^X(\Sigma_{pc}\mathbf{D}_{pc}h_{pc}\frac{1}{J}D^X w_{pc})+D^Y(\Sigma_{pc}\mathbf{D}_{pc}h_{pc}\frac{1}{J}D^Y w_{pc})\\ &+D^X(k_T\frac{1}{J}D^X T)+D^Y(k_T\frac{1}{J}D^Y T)\Big\}\end{aligned}\tag{3.17}$$

3.1.3 Condensation and Source Terms

The condensation terms M_c in (2.1), and the source terms q_{pc} and $\Sigma_p h_p q_p$ in (2.1) and (2.2) appear in the transformed equations without change.

3.1.4 The Transformed Transport Equations

Combining equations (3.11), (3.12), (3.16) and (3.17) with the above discussion of the condensation and source terms, we conclude that the transport equations (2.1) and (2.2) transform, respectively, to

$$D_t(\phi S_p \rho_p w_{pc}) - M_c - q_{pc} = -\frac{1}{J}\left\{D^X(\tau_p w_{pc}\frac{1}{J}D^X\Phi) + D^Y(\tau_p w_{pc}\frac{1}{J}D^Y\Phi)\right\}$$
$$-\frac{1}{J}\left\{D^X(\mathbf{D}_{pc}\frac{1}{J}D^X w_{pc}) + D^Y(\mathbf{D}_{pc}\frac{1}{J}D^Y w_{pc})\right\} \qquad (3.18)$$

and

$$D_t(\Sigma_p \phi S_p \rho_p h_p + (1-\phi)\rho_r h_r) - \Sigma_p q_p h_p$$
$$= -\frac{1}{J}\left\{D^X(\Sigma_p \tau_p h_p \frac{1}{J}D^X\Phi) + D^Y(\Sigma_p \tau_p h_p \frac{1}{J}D^Y\Phi)\right\}$$
$$-\frac{1}{J}\left\{D^X(\Sigma_{pc}\mathbf{D}_{pc}h_{pc}\frac{1}{J}D^X w_{pc}) + D^Y(\Sigma_{pc}\mathbf{D}_{pc}h_{pc}\frac{1}{J}D^Y w_{pc})\right\}$$
$$-\frac{1}{J}\left\{D^X(k_T\frac{1}{J}D^X T) + D^Y(k_T\frac{1}{J}D^Y T)\right\} \qquad (3.19)$$

where the operators D_t, D^X and D^Y are defined by equations (3.13) and (3.14).

3.2 The Transformation of the Matching Conditions

Although the matching conditions (2.5) and (2.6) do not contain any derivatives, they nonetheless contain terms, such as $\nabla\Phi\cdot\underline{n}$ and $\underline{V_f}\cdot\underline{n}$, which are changed significantly by the coordinate transformation (3.01).

3.2.1 The Normal Vector

Assuming that the steam front is reasonably smooth, it is possible to define, for each point on the steam front, a tangent vector, i.e. a vector which is tangent to the steam front at that point. Up to a scaling factor, this tangent vector is unique (since we are considering only two-dimensional simulations). The normal

vector at any point on the steam front may, then, be defined as the vector which

a) is perpendicular to the tangent vector,

b) has length 1, and

c) points out of the steam chamber.

Since the coordinate transformation has been chosen so that the $r=1$ curve coincides with the steam front, the formulae for the components of the tangent vector $\underline{s}$ are simply

$$s_X = c_s \left.\frac{\partial X}{\partial \theta}\right|_{r=1} \qquad s_Y = c_s \left.\frac{\partial Y}{\partial \theta}\right|_{r=1} \tag{3.20}$$

where c_s is a scale factor, whose value does not matter, as we shall see. The normal vector, then, has coordinates given by the formulae

$$n_X = c_n \left.\frac{\partial Y}{\partial \theta}\right|_{r=1} \qquad n_Y = -c_n \left.\frac{\partial X}{\partial \theta}\right|_{r=1} \tag{3.21}$$

where, in order that the normal vector has length 1 and points out of the steam chamber,

$$c_n = \left\{ \left(\left.\frac{\partial Y}{\partial \theta}\right|_{r=1} \right)^2 + \left(\left.\frac{\partial X}{\partial \theta}\right|_{r=1} \right)^2 \right\}^{-1/2} \tag{3.22}$$

Equations (3.02) may be used to evaluate (3.21) and (3.22); the result is

$$c_n = \frac{1}{\sqrt{R(\theta,t)^2 + R_\theta(\theta,t)^2}} \tag{3.23}$$

$$n_X = \frac{R(\theta,t)\cos\theta + R_\theta(\theta,t)\sin\theta}{\sqrt{R(\theta,t)^2 + R_\theta(\theta,t)^2}} \qquad n_Y = \frac{R(\theta,t)\sin\theta - R_\theta(\theta,t)\cos\theta}{\sqrt{R(\theta,t)^2 + R_\theta(\theta,t)^2}} \tag{3.24}$$

3.2.2 The Normal Gradients

The transformed formulae for $\nabla\Phi\cdot\underline{n}$, $\nabla w_c\cdot\underline{n}$, and $\nabla T\cdot\underline{n}$ are all analogous. Therefore, we consider only $\nabla\Phi\cdot\underline{n}$.

In the X, Y coordinate system, the formula for $\nabla\Phi\cdot\underline{n}$ is simply

$$\nabla\Phi\cdot\underline{n}=\frac{\partial\Phi}{\partial X}\,n_X+\frac{\partial\Phi}{\partial Y}\,n_Y \tag{3.25}$$

The partial derivatives $\partial\Phi/\partial X$ and $\partial\Phi/\partial Y$ in (3.25) can be transformed to $\partial\Phi/\partial r$ and $\partial\Phi/\partial\theta$ by using part of the system (3.06), namely

$$\begin{bmatrix}\dfrac{\partial\Phi}{\partial X}\\[2ex]\dfrac{\partial\Phi}{\partial Y}\end{bmatrix}=\frac{1}{J}\begin{bmatrix}\dfrac{\partial Y}{\partial\theta} & -\dfrac{\partial Y}{\partial r}\\[2ex]-\dfrac{\partial X}{\partial\theta} & \dfrac{\partial X}{\partial r}\end{bmatrix}\begin{bmatrix}\dfrac{\partial\Phi}{\partial r}\\[2ex]\dfrac{\partial\Phi}{\partial\theta}\end{bmatrix} \tag{3.26}$$

where J is the Jacobian given in equation (3.03), the derivatives of X and Y with respect to r and θ are given in equations (3.02), and everything is evaluated at $r=1$.

Although it is possible to substitute (3.24) and (3.26) directly into (3.25), the calculations are simplified if a less direct approach is used. First substitute equation (3.26) into (3.25), and rearrange:

$$\nabla\Phi\cdot\underline{n}=\left\{\frac{1}{J}\left\{\left[\frac{\partial Y}{\partial\theta}\,n_X-\frac{\partial X}{\partial\theta}\,n_Y\right]\frac{\partial\Phi}{\partial r}+\left[-\frac{\partial Y}{\partial r}\,n_X+\frac{\partial X}{\partial r}\,n_Y\right]\frac{\partial\Phi}{\partial\theta}\right\}\right\}_{r=1} \tag{3.27}$$

The coefficient of the $\partial\Phi/\partial r$ term in (3.27) is readily evaluated using equations (3.21), (3.22) and (3.23):

$$\left[\frac{\partial Y}{\partial\theta}\,n_X-\frac{\partial Y}{\partial\theta}\,n_Y\right]_{r=1}=\frac{1}{c_n}=\sqrt{R(\theta,t)^2+R_\theta(\theta,t)^2} \tag{3.28}$$

The coefficient of the $\partial\Phi/\partial\theta$ term in (3.27) is calculated using equations (3.02) and (3.24):

$$\left[-\frac{\partial Y}{\partial r}\,n_X+\frac{\partial X}{\partial r}\,n_Y\right]_{r=1}=\frac{-R(\theta,t)R_\theta(\theta,t)}{\sqrt{R(\theta,t)^2+R_\theta(\theta,t)^2}} \tag{3.29}$$

Finally, substitution of (3.29) into (3.27) yields the desired result:

$$\nabla\Phi\cdot\underline{n}=\frac{1}{\sqrt{R(\theta,t)^2+R_\theta(\theta,t)^2}}\left\{\left[1+\frac{R_\theta(\theta,t)^2}{R(\theta,t)^2}\right]\frac{\partial\Phi}{\partial r}-\frac{R_\theta(\theta,t)}{R(\theta,t)}\,\frac{\partial\Phi}{\partial\theta}\right\}_{r=1} \tag{3.30}$$

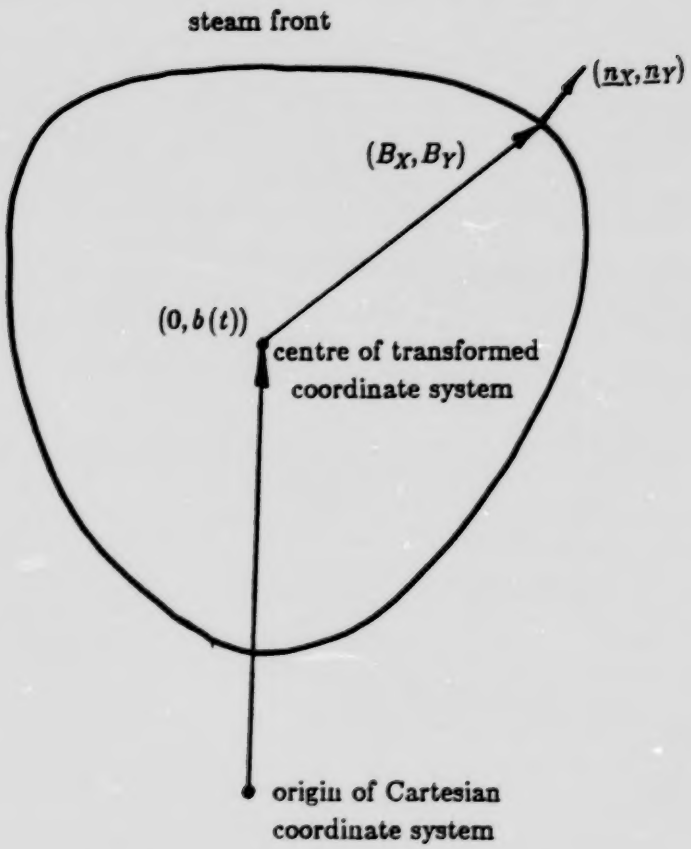


FIGURE 3.1 - Three vectors used in the transformation of $\underline{V}_f \cdot \underline{n}$.

3.2.3 The Normal Component of the Front Velocity

For each instant in time, the steam front defines a curve in the X, Y coordinate system. This sequence of curves enables one to define a normal component $(\underline{V_f}\cdot\underline{n})$ of the front velocity, but not the tangential component. Indeed, because of the complex nature of the fluid flow, it appears to be very difficult, if not impossible, to define a tangential front velocity. Fortunately, only the normal component is needed for the matching conditions.

Consider the line segment in figure 3.1 joining the centre of the coordinate system with a point on the steam front, and let (B_X, B_Y) denote the difference between the coordinates of these two points. The velocity of the centre of the coordinate system is $\left(0, \frac{db(t)}{dt}\right)$ and the velocity of the point on the steam front may be taken to be $(\underline{V_f}\cdot\underline{n})(n_X, n_Y)$. Therefore, the rate of change of (B_X, B_Y) is given by

$$\frac{dB_X}{dt} = (\underline{V_f}\cdot\underline{n})\, n_X \qquad \frac{dB_Y}{dt} = (\underline{V_f}\cdot\underline{n})\, n_Y - \frac{db(t)}{dt} \tag{3.31}$$

With respect to the (r, θ) coordinate system, the vector (B_X, B_Y) satisfies the equations

$$B_X = R(\theta,t)\cos\theta \qquad B_Y = R(\theta,t)\sin\theta \tag{3.32}$$

Take the total derivatives of B_X and B_Y with respect to time, and compare with equations (3.31):

$$\begin{aligned}(\underline{V_f}\cdot\underline{n})\, n_X &= R_t(\theta,t)\cos\theta + R_\theta(\theta,t)\frac{d\theta}{dt}\cos\theta - R(\theta,t)\sin\theta\frac{d\theta}{dt} \\ &= R_t(\theta,t)\cos\theta - n_Y\sqrt{R(\theta,t)^2 + R_\theta(\theta,t)^2}\,\frac{d\theta}{dt}\end{aligned} \tag{3.33}$$

$$\begin{aligned}-\frac{db(t)}{dt} + (\underline{V_f}\cdot\underline{n})\, n_Y &= R_t(\theta,t)\sin\theta + R_\theta(\theta,t)\frac{d\theta}{dt}\sin\theta + R(\theta,t)\cos\theta\frac{d\theta}{dt} \\ &= R_t(\theta,t)\sin\theta + n_X\sqrt{R(\theta,t)^2 + R_\theta(\theta,t)^2}\,\frac{d\theta}{dt}\end{aligned} \tag{3.34}$$

The next step is to eliminate the $d\theta/dt$ terms by multiplying (3.33) by n_X, (3.34) by n_Y, and adding the resulting equations together:

$$(\underline{V_f}\cdot\underline{n})(n_X^2 + n_Y^2) = R_t(\theta,t)\,|n_X\cos\theta + n_Y\sin\theta| + n_Y\frac{db(t)}{dt} \tag{3.35}$$

Since $\underline{n}$ is a unit vector, $n_X^2 + n_Y^2 = 1$. Finally, substitute the formulae (3.24) for n_X and n_Y to obtain

$$\underline{V_f} \cdot \underline{n} = \frac{R(\theta,t)}{\sqrt{R(\theta,t)^2 + R_\theta(\theta,t)^2}} \left\{ R_t(\theta,t) + \left[\frac{db(t)}{dt} \right] \left[\sin\theta - \frac{R_\theta(\theta,t)}{R(\theta,t)} \cos\theta \right] \right\} \quad (3.36)$$

Since the tangential front velocity is undefined, one could introduce an artificial tangential velocity component in order to obtain a shorter derivation of (3.36). In order to do this, define the front velocity so that the angle of the line segment does not change, i.e. $d\theta/dt = 0$. Then, the front velocity (V_{fX}, V_{fY}) must satisfy the equations

$$V_{fX} = R_t(\theta,t)\cos\theta \qquad V_{fY} = R_t(\theta,t)\sin\theta + \frac{db(t)}{dt}$$

Then, the normal component of the front velocity is given by

$$\begin{aligned} \underline{V_f} \cdot \underline{n} &= V_{fX} n_X + V_{fY} n_Y \\ &= R_t(\theta,t)\left[\cos\theta\, n_X + \sin\theta\, n_Y\right] + \frac{db(t)}{dt} n_Y \end{aligned}$$

which is equivalent to equation (3.35).

4. THE FINITE-DIFFERENCE APPROXIMATION

The use of the finite-difference method for petroleum reservoir simulation is well-established. This technique is described in detail by Thomas[1], by Peaceman[2], and by Aziz and Settari[3], among others.

An advantage of the front-tracking formulation is that a simple rectilinear grid may be used for the finite-difference approximation. Although this grid is simple, it is sufficiently flexible that a finer resolution may be obtained in the most interesting parts of the reservoir, e.g. near the steam front, than elsewhere. Thus, a set of grid lines θ_i, $i=1,...,N_\theta$, $\theta_1=\theta_{N_\theta+1}$ and a set of grid lines r_j, $j=1,...,N_r$, $r_1=0$ are selected, and the grid is defined as the set of intersection points (r_j,θ_i), $i=1,...,N_\theta$, $j=2,...,N_r$.

Two special cases should be noted. At the origin, there is only one grid point instead of a ring of grid points. Thus, for $r=r_1=0$, θ is undefined. At the steam front, there are two rings of grid points, representing the state of the reservoir on both sides of the discontinuity at the steam front. These two rings of grid points may be referred to by the subscripts $jF-$ and $jF+$, so that $(jF+)-(jF-)=1$, but $r_{jF+}=r_{jF-}$.

In the following description of our finite-difference approximations, the i subscript refers to θ, the j subscript refers to r, and the n superscript refers to the time level. Only for the material balance equations are the finite-difference approximations shown; the approximations for the enthalpy balance equations are analogous.

4.1 Discretization of the Transport Equations

4.1.1 Left Side of Equation (2.1)

In addition to the expected derivative with respect to t, the left side of equation (2.1) also contains derivatives with respect to r and θ; these latter derivatives arise from the coordinate transformation. These derivatives are approximated by modified harmonic means of one-sided finite-differences as follows:

Let $H_m(\cdot,\cdot)$ denote the modified harmonic mean defined by

$$H_m(a_1,a_2)=\begin{cases}\dfrac{2a_1a_2}{a_1+a_2} & \text{if } a_1a_2>0\\ 0 & \text{if } a_1a_2\le 0\end{cases} \tag{4.01}$$

Then, the finite-difference approximation used for the left side of equation (2.1) is given by eqn. (4.02) for all grid points except the central grid point,

$$\begin{aligned}&\{D_t(\phi S_p\rho_p w_{pc})-\sigma_p M_c-q_{pc}\}_{i,j}^n\\ &\approx\frac{(\phi S_p\rho_p w_{pc})_{i,j}^n-(\phi S_p\rho_p w_{pc})_{i,j}^{n-1}}{\delta t}-\sigma_p(M_c)_{i,j}^n-(q_{pc})_{i,j}^n\\ &-\left[\frac{db(t)}{dt}\right]^n\frac{\cos\theta_i}{r_jR_i^n}H_m\left(\frac{(\phi S_p\rho_p w_{pc})_{i+1,j}^n-(\phi S_p\rho_p w_{pc})_{i,j}^n}{\theta_{i+1}-\theta_i},\frac{(\phi S_p\rho_p w_{pc})_{i,j}^n-(\phi S_p\rho_p w_{pc})_{i-1,j}^n}{\theta_i-\theta_{i-1}}\right)\\ &-\frac{1}{R_i^n}\left\{\frac{r_j(R_i^n-R_i^{n-1})}{\delta t}+\left[\frac{db(t)}{dt}\right]^n\left[\sin\theta_i-\left[\frac{dR}{d\theta}\right]_i^n\frac{\cos\theta_i}{R_i^n}\right]\right\}\times\\ &H_m\left(\frac{(\phi S_p\rho_p w_{pc})_{i,j+1}^n-(\phi S_p\rho_p w_{pc})_{i,j}^n}{r_{j+1}-r_j},\frac{(\phi S_p\rho_p w_{pc})_{i,j}-(\phi S_p\rho_p w_{pc})_{i,j-1}}{r_j-r_{j-1}}\right)\end{aligned} \tag{4.02}$$

and by equation (4.03) for the central grid point.

$$\begin{aligned}&\{D_t(\phi S_p\rho_p w_{pc})-\sigma_p M_c-q_{pc}\}_{j=0}^n\\ &\approx\frac{(\phi S_p\rho_p w_{pc})_{j=0}^n-(\phi S_p\rho_p w_{pc})_{j=0}^{n-1}}{\delta t}-\sigma_p(M_c)_{j=0}^n-(q_{pc})_{j=0}^n\end{aligned} \tag{4.03}$$

At the boundaries*, the formula (4.02) is not directly usable. Instead, the terms containing the harmonic means are neglected.

The $(dR/d\theta)_i^n$ factor in equation (4.01) is approximated as

$$\left[\frac{dR}{d\theta}\right]_i^n\approx\left[\frac{\theta_i-\theta_{i-1}}{\theta_{i+1}-\theta_{i-1}}\right]\frac{R_{i+1}^n-R_i^n}{\theta_{i+1}-\theta_i}+\left[\frac{\theta_{i+1}-\theta_i}{\theta_{i+1}-\theta_{i-1}}\right]\frac{R_i^n-R_{i-1}^n}{\theta_i-\theta_{i-1}} \tag{4.04}$$

If $\theta_{i+1}-\theta_i=\theta_i-\theta_{i-1}$, then this formula reduces to

* If the 2-fold symmetry is exploited in order to save computation time, then the line of symmetry is counted as two boundaries in the θ-direction.

$$\left(\frac{dR}{d\theta}\right)_i^n \approx \frac{R_{i+1}^n - R_{i-1}^n}{\theta_{i+1} - \theta_{i-1}} \tag{4.05}$$

which is simpler, but less accurate in the general case. At the θ boundary, the $i\pm1$ subscripts are replaced by i, as appropriate.

4.1.2 Right Side of Equation (2.1)

The right side of equation (2.1) contains two analogous pairs of terms:

$$\begin{aligned} &-\frac{1}{J}\{D^X(\tau_p w_{pc}\frac{1}{J}D^X\Phi) + D^Y(\tau_p w_{pc}\frac{1}{J}D^Y\Phi)\} \\ &-\frac{1}{J}\{D^X(\mathbf{D}_{pc}\frac{1}{J}D^X w_{pc}) + D^Y(\mathbf{D}_{pc}\frac{1}{J}D^Y w_{pc})\} \end{aligned} \tag{4.06}$$

The operators D^X and D^Y are defined by equations (3.14)

$$D^X \equiv -\frac{\partial X}{\partial\theta}\frac{\partial}{\partial r} + \frac{\partial X}{\partial r}\frac{\partial}{\partial\theta}, \quad D^Y \equiv \frac{\partial Y}{\partial\theta}\frac{\partial}{\partial r} - \frac{\partial Y}{\partial r}\frac{\partial}{\partial\theta} \tag{3.14}$$

where the four partial derivatives are given in equations (3.02). It suffices to describe the finite-difference approximation to either one of the equations (4.06), e.g. the first, since the same approximation method was used for both of them, and also for the terms on the right side of the enthalpy balance (2.2). Except for the grid point at the centre of the coordinate system, the following approximation was used (the superscript n is omitted because it is the same for every term)

$$\begin{aligned} &\{-\frac{1}{J}\{D^X(\tau_p w_{pc}\frac{1}{J}D^X\Phi) + D^Y(\tau_p w_{pc}\frac{1}{J}D^Y\Phi)\}\}_{i,j} \\ &\approx -\left(\frac{1}{J}\right)_{i,j}\left\{-\left(\frac{\partial X}{\partial\theta}\right)_{i,j}\left[\frac{(\tau_p w_{pc}J^{-1})_{i,j+\frac{1}{2}}(D^X\Phi)_{i,j+\frac{1}{2}} - (\tau_p w_{pc}J^{-1})_{i,j-\frac{1}{2}}(D^X\Phi)_{i,j-\frac{1}{2}}}{r_{j+\frac{1}{2}} - r_{j-\frac{1}{2}}}\right]\right. \\ &\qquad + \left(\frac{\partial X}{\partial r}\right)_{i,j}\left[\frac{(\tau_p w_{pc}J^{-1})_{i+\frac{1}{2},j}(D^X\Phi)_{i+\frac{1}{2},j} - (\tau_p w_{pc}J^{-1})_{i-\frac{1}{2},j}(D^X\Phi)_{i-\frac{1}{2},j}}{\theta_{i+\frac{1}{2}} - \theta_{i-\frac{1}{2}}}\right] \\ &\qquad + \left(\frac{\partial Y}{\partial\theta}\right)_{i,j}\left[\frac{(\tau_p w_{pc}J^{-1})_{i,j+\frac{1}{2}}(D^Y\Phi)_{i,j+\frac{1}{2}} - (\tau_p w_{pc}J^{-1})_{i,j-\frac{1}{2}}(D^Y\Phi)_{i,j-\frac{1}{2}}}{r_{j+\frac{1}{2}} - r_{j-\frac{1}{2}}}\right] \end{aligned}$$

$$+\left(\frac{\partial Y}{\partial r}\right)_{i,j}\left[\frac{(\tau_p w_{pc} J^{-1})_{i+\frac{1}{2},j}(D^Y\Phi)_{i+\frac{1}{2},j}-(\tau_p w_{pc} J^{-1})_{i-\frac{1}{2},j}(D^Y\Phi)_{i-\frac{1}{2},j}}{\theta_{i+\frac{1}{2}}-\theta_{i-\frac{1}{2}}}\right]\Bigg\} \tag{4.07}$$

where

$$(D^X\Phi)_{i+\frac{1}{2},j} \equiv -\left(\frac{\partial X}{\partial\theta}\right)_{i\pm\frac{1}{2},j}\left[\frac{\Phi_{i\pm1,j+1}+\Phi_{i,j+1}-\Phi_{i\pm1,j-1}-\Phi_{i,j-1}}{2(r_{j+1}-r_{j-1})}\right] + \left(\frac{\partial X}{\partial r}\right)_{i\pm\frac{1}{2},j}\left[\frac{\Phi_{i\pm1,j}-\Phi_{i,j}}{\theta_{i\pm1}-\theta_i}\right] \tag{4.08}$$

$$(D^X\Phi)_{i,j\pm\frac{1}{2}} \equiv -\left(\frac{\partial X}{\partial\theta}\right)_{i,j\pm\frac{1}{2}}\left[\frac{\Phi_{i,j\pm1}-\Phi_{i,j}}{r_{j\pm1}-r_j}\right] + \left(\frac{\partial X}{\partial r}\right)_{i,j\pm\frac{1}{2}}\left[\left(\frac{\theta_i-\theta_{i-1}}{\theta_{i+1}-\theta_{i-1}}\right)\left(\frac{\Phi_{i+1,j\pm1}+\Phi_{i+1,j}-\Phi_{i,j\pm1}-\Phi_{i,j}}{2(\theta_{i+1}-\theta_i)}\right) + \left(\frac{\theta_{i+1}-\theta_i}{\theta_{i+1}-\theta_{i-1}}\right)\left(\frac{\Phi_{i,j\pm1}+\Phi_{i,j}-\Phi_{i-1,j\pm1}-\Phi_{i-1,j}}{2(\theta_i-\theta_{i-1})}\right)\right] \tag{4.09}$$

and $(D^Y\Phi)_{i\pm\frac{1}{2},j}$ and $(D^Y\Phi)_{i,j\pm\frac{1}{2}}$ are defined by analogous expressions. The other terms with half-subscripts in equation (4.07) are defined as follows:

$$r_{j\pm\frac{1}{2}} = \frac{1}{2}(r_j+r_{j\pm1}) \tag{4.10}$$

$$\theta_{i\pm\frac{1}{2}} = \frac{1}{2}(\theta_i+\theta_{i\pm1}) \tag{4.11}$$

$$(J^{-1})_{i,j\pm\frac{1}{2}} = (J_{i,j\pm\frac{1}{2}})^{-1} = (r_{j\pm\frac{1}{2}}(R_i)^2)^{-1}, \quad R_i = R(\theta_i, t^n) \tag{4.12}$$

$$(J^{-1})_{i\pm\frac{1}{2},j} = (J_{i\pm\frac{1}{2},j})^{-1} = (r_j[\tfrac{1}{2}(R_i+R_{i\pm1})]^2)^{-1} \tag{4.13}$$

$$(\tau_p w_{pc})_{i,j\pm\frac{1}{2}} = (\tau_p w_{pc})_{i,j\pm\frac{1}{2},\text{upstream}} = \begin{cases}(\tau_p w_{pc})_{i,j\pm1} & \text{if } (\Phi_p)_{i,j\pm1} > (\Phi_p)_{i,j}\\ (\tau_p w_{pc})_{i,j} & \text{if } (\Phi_p)_{i,j\pm1} < (\Phi_p)_{i,j}\\ \text{irrelevant} & \text{if } (\Phi_p)_{i,j\pm1} = (\Phi_p)_{i,j}\end{cases} \tag{4.14}$$

$$(\tau_p w_{pc})_{i\pm\frac{1}{2},j} = (\tau_p w_{pc})_{i\pm\frac{1}{2},j,\text{upstream}} = \begin{cases}(\tau_p w_{pc})_{i\pm1,j} & \text{if } (\Phi_p)_{i\pm1,j} > (\Phi_p)_{i,j}\\ (\tau_p w_{pc})_{i,j} & \text{if } (\Phi_p)_{i\pm1,j} < (\Phi_p)_{i,j}\\ \text{irrelevant} & \text{if } (\Phi_p)_{i\pm1,j} = (\Phi_p)_{i,j}\end{cases} \tag{4.15}$$

The finite-difference approximation for the flow terms in the molar and enthalpy balances contains other terms with half-subscripts which do not appear in equation (4.07). These terms are defined as follows:

$$(\mathbf{D}_{pc})_{i,j\pm\frac{1}{2}} = \frac{1}{2}\left[(\mathbf{D}_{pc})_{i,j\pm1}+(\mathbf{D}_{pc})_{i,j}\right] \tag{4.16}$$

$$(\mathbf{D}_{pc})_{i\pm\frac{1}{2},j} = \frac{1}{2}\left[(\mathbf{D}_{pc})_{i\pm1,j}+(\mathbf{D}_{pc})_{i,j}\right] \tag{4.17}$$

$$(k_T)_{i,j\pm\frac{1}{2}} = \frac{1}{2}\left[(k_T)_{i,j\pm1}+(k_T)_{i,j}\right] \tag{4.18}$$

$$(k_T)_{i\pm\frac{1}{2},j} = \frac{1}{2}\left[(k_T)_{i\pm1,j}+(k_T)_{i,j}\right] \tag{4.19}$$

$$(h_{pc})_{i,j\pm\frac{1}{2}} = (h_{pc})_{i,j\pm\frac{1}{2},\text{upstream}} \quad \text{(analogous to (4.14))} \tag{4.20}$$

$$(h_{pc})_{i\pm\frac{1}{2},j} = (h_{pc})_{i\pm\frac{1}{2},j,\text{upstream}} \quad \text{(analogous to (4.15))} \tag{4.21}$$

As with the formulae in the previous section, the above formulae are not usable at the boundaries. Instead, the subscripts $i\pm\frac{1}{2}$ and $j\pm\frac{1}{2}$ are replaced by i and j, as appropriate.

The above formulae are also not usable at the central grid point, because the coordinate transformation has a singularity there. Instead, a finite-difference approximation is applied to the flow terms expressed in Cartesian coordinates

$$\frac{\partial}{\partial X}\left[\tau_p w_{pc}\frac{\partial \Phi_p}{\partial X}\right]+\frac{\partial}{\partial Y}\left[\tau_p w_{pc}\frac{\partial \Phi_p}{\partial Y}\right]+\frac{\partial}{\partial X}\left[\mathbf{D}_{pc}\frac{\partial w_{pc}}{\partial X}\right]+\frac{\partial}{\partial Y}\left[\mathbf{D}_{pc}\frac{\partial w_{pc}}{\partial Y}\right] \tag{4.22}$$

First, the fluxes are approximated as follows:

$$\left[\tau_p w_{pc}\frac{\partial \Phi_p}{\partial X}\right]_{i,\frac{1}{2}} \approx (\tau_p w_{pc})_{i,\frac{1}{2},\text{upstream}} \times \frac{1}{2}\left[\left(\frac{\partial \Phi_p}{\partial X}\right)_{i-\frac{1}{2},\frac{1}{2}}+\left(\frac{\partial \Phi_p}{\partial X}\right)_{i+\frac{1}{2},\frac{1}{2}}\right] \tag{4.23}$$

The factor $(\tau_p w_{pc})_{i,\frac{1}{2},\text{upstream}}$ is calculated the same as above, in equations (4.14) and (4.15). The factor $\left(\frac{\partial \Phi_p}{\partial X}\right)_{i+\frac{1}{2},\frac{1}{2}}$ is calculated as the coefficient $a_{X,i\pm\frac{1}{2}}$ of a linear fit

$$\Phi_p = a_{0,i\pm\frac{1}{2}} + a_{X,i\pm\frac{1}{2}}X + a_{Y,i\pm\frac{1}{2}}Y \tag{4.24}$$

through the values of Φ_p at the three grid points (-,0), $(i, 1)$ and $(i\pm1,1)$, namely

$(\Phi_p)_0$, $(\Phi_p)_{i,1}$ and $(\Phi_p)_{i\pm1,1}$. Analogous approximations are used for $\left(\tau_p w_{pc} \dfrac{\partial \Phi_p}{\partial Y}\right)_{i,\frac{1}{2}}$, $\left(\mathbf{D}_{pc} \dfrac{\partial w_{pc}}{\partial X}\right)_{i,\frac{1}{2}}$ and $\left(\mathbf{D}_{pc} \dfrac{\partial w_{pc}}{\partial Y}\right)_{i,\frac{1}{2}}$.

Next, after these fluxes have been calculated, approximations for $\dfrac{\partial}{\partial X}\left(\tau_p w_{pc} \dfrac{\partial \Phi_p}{\partial X}\right)$, $\dfrac{\partial}{\partial Y}\left(\tau_p w_{pc} \dfrac{\partial \Phi_p}{\partial Y}\right)$ and the other flow terms are obtained by fitting each set of fluxes, via the linear least-squares method, to a linear function of the form

$$b_0 + b_X X + b_Y Y \tag{4.25}$$

and by selecting either the X-derivative, b_X, or the Y-derivative, b_Y, as appropriate.

4.2 Discretization of the Matching Conditions

The finite-difference approximation which we use for the left side of equation (2.5) is

$$\{\,[(\phi S_p \rho_p w_{pc})^- - (\phi S_p \rho_p w_{pc})^+](\underline{V}_f \cdot \underline{n}) \;-\; \sigma_p \overline{M}_c\,\}_i^n$$

$$\approx\; [(\phi S_p \rho_p w_{pc})^n_{i,jF-} - (\phi S_p \rho_p w_{pc})^n_{i,jF+}](\underline{V}_f \cdot \underline{n})^n_i \;-\; \sigma_p (\overline{M}_c)^n_i \tag{4.26}$$

In equation (4.26), the subscripts $jF+$ and $jF-$ refer to the two sides of the front, and (from equation (3.36))

$$(\underline{V}_f \cdot \underline{n})^n_i = \frac{R^n_i}{F^n_i}\left\{\frac{R^n_i - R^{n-1}_i}{\delta t} + \left(\frac{db(t)}{dt}\right)^n\left[\sin\theta_i - \left(\frac{dR}{d\theta}\right)^n_i \frac{\cos\theta_i}{R^n_i}\right]\right\} \tag{4.27}$$

where

$$F^n_i = (R^n_i)^2 + \left[\left(\frac{dR}{d\theta}\right)^n_i\right]^2 \tag{4.28}$$

and $(dR/d\theta)^n_i$ is as defined in equation (4.04).

The finite-difference approximation which we use for the right side of equation (2.05) is

$$\{-(\tau_p w_{pc}\nabla\Phi_p\cdot\underline{n})^- +(\tau_p w_{pc}\nabla\Phi_p\cdot\underline{n})^+ -(\mathbf{D}_{pc}\nabla w_{pc}\cdot\underline{n})^- +(\mathbf{D}_{pc}\nabla w_{pc}\cdot n)^+\}_i^n$$

$$\approx -(\tau_p w_{pc})_{i,jF-\frac{1}{2}}^n(\nabla\Phi_p\cdot\underline{n})_{i,jF-}^n +(\tau_p w_{pc})_{i,jF+\frac{1}{2}}^n(\nabla\Phi_p\cdot\underline{n})_{i,jF+}^n$$

$$-(\mathbf{D}_{pc})_{i,jF-\frac{1}{2}}^n(\nabla w_{pc}\cdot\underline{n})_{i,jF-}^n +(\mathbf{D}_{pc})_{i,jF+\frac{1}{2}}^n(\nabla w_{pc}\cdot\underline{n})_{i,jF+}^n \qquad (4.29)$$

In equation (4.29), the factors $(\tau_p w_{pc})_{i,jF\pm\frac{1}{2}}^n$ and $(\mathbf{D}_{pc})_{i,jF\pm\frac{1}{2}}^n$ are calculated using the formulae (4.14), (4.15), (4.16) and (4.17). The factors $(\nabla w_{pc}\cdot\underline{n})_{i,jF\pm}^n$ are defined by

$$(\nabla w_{pc}\cdot\underline{n})_{i,jF\pm}^n \approx \frac{1}{F_i^n}\left\{\left[1+\left(\frac{(dR/d\theta)_i^n}{R_i^n}\right)^2\right]\left(\frac{(w_{pc})_{i,jF\pm1}^n-(w_{pc})_{i,jF\pm}^n}{r_{jF\pm1}-r_{jF\pm}}\right)\right.$$

$$\left.-\left(\frac{dR}{d\theta}\right)_i^n\frac{1}{R_i^n}\left(\frac{dw_{pc}}{d\theta}\right)_{i,jF\pm}^n\right\} \qquad (4.30)$$

where F_i^n is defined in equation (4.28), $(dR/d\theta)_i^n$ is defined in equation (4.07) and $(dw_{pc}/d\theta)_{i,jF\pm}^n$ is defined by an equation analogous to (4.07):

$$\left(\frac{dw_{pc}}{d\theta}\right)_{i,jF\pm}^n \approx \left(\frac{\theta_i-\theta_{i-1}}{\theta_{i+1}-\theta_{i-1}}\right)\frac{(w_{pc})_{i+1,jF\pm}^n-(w_{pc})_{i,jF\pm}^n}{\theta_{i+1}-\theta_i}$$

$$+\left(\frac{\theta_{i+1}-\theta_i}{\theta_{i+1}-\theta_{i-1}}\right)\frac{(w_{pc})_{i,jF\pm}^n-(w_{pc})_{i-1,jF\pm}^n}{\theta_i-\theta_{i-1}} \qquad (4.31)$$

Note that $r_{jF\pm}=1$. The approximation for $(\nabla\Phi_p\cdot\underline{n})_{i,jF\pm}^n$ is analogous except that $(\Phi_p)_{i,jF+}^n$ and $(\Phi_p)_{i,jF-}^n$ may both be replaced by $(\Phi_p\cdot\underline{n})_{i,jF}^n$ since Φ_p is continuous at the steam front, whereas w_{pc} is not.

4.3 Which Discretized Equations Should Be Used?

Due to the hyperbolic nature of the governing equations, care must be taken in selecting the discretized equations to include in the big system of coupled non-linear equations. A careless selection can lead to an incorrect representation. At interior grid points, the choice is straightforward. The discretized balances on water, enthalpy, and the N_c hydrocarbon components contribute N_c+2 equations, which equals the number of unknowns at each interior grid point. Inside the steam

zone, these unknowns are P, S_g, S_w and $x_1,\ldots,x_{N_c-1}$. Outside the steam zone, the N_c+2 unknowns are P, T, S_w and $x_1,\ldots,x_{N_c-1}$.

At the steam front, the selection is a little less straightforward. To elucidate the problem, consider the bimaterial conduction problem. At the bimaterial interface, there are two matching conditions,

$$k^-(\nabla T\cdot\underline{n})\,|^- = k^+(\nabla T\cdot\underline{n})\,|^+$$

$$T^- = T^+$$

and two unknowns, T^- and T^+. Hence, the number of unknowns matches the number of matching conditions, and one need not attempt to apply the discretized governing equation *at* the interface. In fact, it would be incorrect to do so.

The steam injection problem is not as straightforward as the conduction problem since, whereas the conduction problem is elliptic in nature, the steam injection problem is hyperbolic in certain variables. The elliptic character of the heat conduction problem requires the temperature to be continuous at the interface. The hyperbolic nature of the steam injection problem, on the other hand, results in certain variables being discontinuous at the steam front. Thus certain variables take on different values on each side of the steam front, and for each of these variables, we have *two* unknowns at the steam front for which we must solve. Thus there are more unknowns than available matching conditions.

The solution to the above dilemma, not surprisingly, is intimately related to the hyperbolic nature of the equations. For hyperbolic equations, we *can* apply the discretized form of the governing equations at the interface. Indeed, we must if we are to have sufficient equations to solve for all unknowns. Furthermore, the directional nature of information transfer in hyperbolic equations provides the justification for applying the discretized governing equations on one side of the front, while using the matching conditions on the other side.

As an example to demonstrate more clearly the handling of hyperbolic equations, consider the simple one-dimensional convective problem

$$\frac{\partial u}{\partial t} + a\,\frac{\partial u}{\partial z} = 0 \qquad z\in[0,1],\ a>0,\ u(0,t)\ \text{given}$$

To compute $u(1,t)$ using finite-difference equations, one would include an

upstream-weighted, discretized governing equation at z=1. It would be incorrect to attempt to force $u(1,t)$ to obey any sort of boundary condition. In the case of a steam front, the upstream side of the front may be regarded as analogous to the z=1 boundary, with information being carried to it, whereas the downstream side of the steam front is analogous to the z=0 boundary of a second hyperbolic equation coupled to the upstream hyperbolic equation by a matching condition.

Thus the proper method of handling hyperbolic-type equations is to use an upstream-weighted, discretized governing equation on the upstream side of the front, and to apply the appropriate matching condition as a "boundary condition" on the downstream side.

If the governing equation is elliptic in nature, then the corresponding variable is continuous across the interface (i.e. the matching condition ensures equality of the variable on both sides of the front). The governing equation is not applied at the interface.

This explanation is still not complete since, even for simple problems, it is not obvious whether the upstream direction should be defined according to the usual stationary frame of reference, or according to a frame of reference in which the steam front is stationary. In fact, the second option is correct since what is important is the direction from which information is reaching the front, and this is established based on velocities relative to the front velocity. Therefore, in the following discussion, when motion relative to the steam front is mentioned, it should be understood that a frame of reference is used, in which the steam front is stationary. In particular, the sand phase is usually moving relative to the steam front.

Another complication potentially arises if all fluid phases are not moving in the same direction relative to the steam front. For example, in a steam drive, one expects that the water and vapour phases will move in one direction, and the sand phase in the other direction relative to the steam front. The bitumen phase may move in either direction. Hence, the upstream direction for each phase must be identified and accounted for properly in its respective phase balance.

Unfortunately, the governing equations involve balances of mass and enthalpy that encompass contributions from *all* phases. If heat conduction is significant, then the enthalpy balance assumes an elliptic character and the requirement of

temperature continuity allows the governing equation to be discarded on both sides of the front. However, in the case of the mass balances, it is necessary to determine the net flux direction of each species (relative to the front) and to apply the relevant transport equation on the upstream side of the front, and the relevant species matching condition on the downstream side.

After all the above considerations, it is concluded that at each point on the steam front, we have $2N_c+3$ unknowns (S_w^-, S_w^+, S_g, $\underline{V_f}\cdot\underline{n}$, P, $x_1^-, \cdots, x_{N_c-1}^-$, $x_1^+, \cdots, x_{N_c-1}^+$), N_c+2 matching conditions (water, N_c oil components, and enthalpy), and N_c+1 transport equations (water and N_c oil component balances). The enthalpy transport equation does not enter at the steam front for the reason explained in the preceding paragraph.

In constructing the simulator, it is also important to order the equations and unknowns so that the Jacobian matrix is close to being diagonally dominant. This is reasonably accomplished by the following ordering (the superscript $^+$ denotes the direction *to* which the steam front is moving.

TABLE 4.1. The Order of the Equations and Primary Unknown Variables at the Steam Front.

Equation	Variable
water matching	S_w^-
x_1 matching	x_1^-
x_2 matching	x_2^-
x_3 matching	S_g^-
enthalpy matching	P
water transport	S_w^+
x_1 transport	x_1^+
x_2 transport	x_2^+
x_3 transport	$\underline{V_f}\cdot\underline{n}$

4.4 The Bandwidth Problem

In general, the computation time requirement of any finite-difference simulation is dominated (unless the grid is very coarse) by the time required to solve huge systems of linear equations. Usually, these systems of linear equations have the convenient property that the matrix has a small bandwidth, i.e. the matrix elements are mostly zero, except for a relatively small number of non-zero elements close to the diagonal. If the matrix has a small bandwidth, this fact can be exploited to reduce significantly the computation time required to solve the system(s) of linear equations. Software for doing this is readily available, e.g. in the widely-used LINPACK[4], NAG[5], and IMSL[6] numerical software collections. The terms "banded-matrix linear equation solver" and "general-purpose linear equation solver" are used to distinguish between the software which exploits the small bandwidth, and the software which does not exploit/require the small bandwidth.

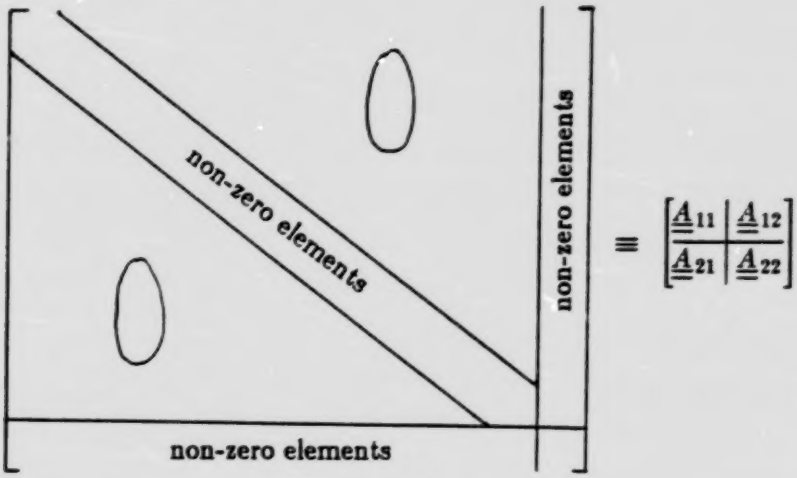
In our simulator, the computation time for solving each system of equations would be reduced by a factor of approximately $(N_r^2/12)$, where N_r is the number of grid points in the r-direction, if a banded-matrix linear equation solver could be used. Unfortunately, our coordinate transformation method causes the matrix to have a small number of non-zero elements far from the diagonal. This rules out the straightforward use of the available software for banded matrices. Instead, we have temporarily accepted the computational penalty which results from using a general-purpose linear equation solver.

4.4.1 Alternatives

One alternative is to develop an iterative method based on neglecting the non-zero elements far from the diagonal. Then, it would be possible to use a banded-matrix linear equation solver. Nevertheless, this approach appears unattractive since our experience has shown that unusual iteration schemes introduce unusual problems into our simulator.

A second alternative is to use a sparse matrix package such as the one developed at the University of Waterloo by Alan George and his students and colleagues[7]. This type of software is designed for matrices with a relatively small number of non-zero elements, but does not impose any restrictions on where the non-zero elements are located. It is not clear how efficiently such a package would exploit the fact that very few of the non-zero elements are far from the diagonal.

A third alternative is to renumber the equations and the unknowns so that the matrix has the following structure



This matrix can be partitioned, and the system of equations can be written as

$$\underline{\underline{A}}_{11}\underline{U}_1 + \underline{\underline{A}}_{12}\underline{U}_2 = \underline{F}_1 \tag{4.32}$$

$$\underline{\underline{A}}_{21}\underline{U}_1 + \underline{\underline{A}}_{22}\underline{U}_2 = \underline{F}_2 \tag{4.33}$$

These equations can be rearranged as

$$(\underline{\underline{A}}_{22} - \underline{\underline{A}}_{21}\underline{\underline{A}}_{11}^{-1}\underline{\underline{A}}_{12})\underline{U}_2 = \underline{F}_2 - \underline{\underline{A}}_{21}\underline{\underline{A}}_{11}^{-1}\underline{F}_1 \tag{4.34}$$

$$\underline{\underline{A}}_{11}\underline{U}_1 = \underline{F}_1 - \underline{\underline{A}}_{12}\underline{U}_2 \tag{4.35}$$

Thus, one would first solve (4.34) for $\underline{U}_2$, and then solve (4.35) for $\underline{U}_1$.

In (4.34), the matrix $\underline{\underline{A}}_{22} - \underline{\underline{A}}_{21}\underline{\underline{A}}_{11}^{-1}\underline{\underline{A}}_{12}$ is quite small. Therefore, the time required to solve (4.34) (not counting the time required to calculate the matrix and right-hand-side of (4.34)) is negligible, even though a general-purpose linear equation solver is used. The most time-consuming part of the calculations in (4.34) and (4.35) is to factor $\underline{\underline{A}}_{11}$. Once this is done, relatively little time is required to

calculate $\underline{\underline{A}}_{11}^{-1}\underline{\underline{A}}_{12}$ and $\underline{\underline{A}}_{11}^{-1}\underline{F}_1$ (*without* calculating $\underline{\underline{A}}_{11}^{-1}$), and eventually the factors of $\underline{\underline{A}}_{11}$ can be used to solve (4.35). But note that $\underline{\underline{A}}_{11}$ has a small bandwidth: therefore, a banded-matrix linear equation solver can be used to factor $\underline{\underline{A}}_{11}$. Thus, we are able to exploit the fact that *most* of the non-zero elements of the original matrix are close to the diagonal.

We propose to implement the second and third alternatives, both separately and in combination, in future versions of the simulator.

References for Chapter 4

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5. A SURVEY OF REPORTED PHYSICAL PROPERTIES FOR THE COLD LAKE RESERVOIR

5.1 Introduction

There is surprisingly little information in the literature concerning the physical properties of the Cold Lake bitumen deposits. Indeed, semi-comprehensive tabulations of the Cold Lake physical properties listed in this report could be found in only five references[8,14a,23,25,35], one of which[23] has several obvious errors, and probably has some less obvious errors as well. The other references cited in this section of the report belong to one of three sets. One set contains references which claim to describe the Cold Lake reservoir, but which collectively list only a handful of the properties of interest for reservoir simulations. For example, many of the references in this set give a value for absolute permeability, but none give any relative permeability data. Many of these references give a value for the density of bitumen, but almost none describe how the density varies with temperature or pressure. Many of these references show how the viscosity of the bitumen varies with temperature, but none describe how the viscosity varies with the amount of methane dissolved. Some of these references describe the composition of the bitumen, and a few give volatility data, but none give enough information to allow one to construct a useful description of the bitumen as a mixture of two or more pseudocomponents.

The second set (which is rather small) contains references[13,17,33,34,39] which describe in detail a few of the physical properties. However, many of the physical properties of interest are not mentioned by any of the references in this set.

The third set (which is also small) contains references[41–45] which do not describe any of the physical properties of the Cold Lake reservoir. Instead, they describe the physical properties of a different reservoir, and thus give a rough guide for the corresponding physical properties of the Cold Lake reservoir.

It is likely that several organizations have unpublished collections of data on Cold Lake physical properties, and that these collections are more detailed and

more accurate than what we have been able to obtain from the published literature. It would be beneficial to gain access to some of this unpublished information.

All quantities have the standard SI units.

5.2 Initial Reservoir Conditions

Many publications contain values for the initial temperature, pressure, and hydrocarbon saturation. These are given in table 5.1. The discrepancies in the published values may be attributed to heterogeneity in the Cold Lake reservoir, to the hydrostatic vertical pressure gradient, and to different definitions of saturation. We selected representative values for the temperature and hydrocarbon saturation from the paper by Reddy et al.[38], since it describes the Cold Lake reservoir in considerable detail. The values of initial reservoir pressure given by Finbow and Koop[9] are the most useful since they give pressure as a function of vertical distance, whereas most publications give only a single representative pressure. While most authors do not mention any vapour phase, three publications suggest that a small amount of vapour may be present. It should be recognized, however, that the accurate measurement of the vapour phase saturation is very difficult due to the disruption of core samples that accompanies decompression as they are brought to surface conditions[45].

With respect to composition of the in situ oil, some distillation curve data are available as indicated in table 5.1. These distillation data can be used to define pseudocomponents for the oil. However, for the purposes of most steam injection simulations, it is sufficient to treat the bitumen as only a two-component mixture of heavy oil and methane. Methane gas-oil ratios of 9.8 m^3/m^3 were reported by Buckles[18] of Esso Resources Canada, and also by Mainland and Lo[32]. Lower values of 7.5 and 6.3 m^3/m^3 were reported by Weinstein et al.[14] and Farouq-Ali[19] respectively. Once again, some degree of variability is to be expected. Indeed, it is this variation in GOR which probably results in a significant part of the observed variation in reservoir pressure as reported in the literature.

TABLE 5.1. A survey of commonly reported reservoir properties - Part 1.

Ref.	Year	Formation	Temperature	Pressure	Hydrocarbon Saturation	Molecular Weight	Distillation data?
1	1973	Clearwater			0.58		
4	1974	Mannville C	55 °F.	440 psi(g?)	0.55?		sat. methane at 455 psia
5	1974		55 °F.	450 psi	0.55		
6	1974/5	Mannville	55 °F.	440 psi	0.55?		
7	1975	Cummings	55 °F.	400 psi?	0.65		
8	1976		55 °F.	440 psia 115 ft. below top	0.65		
9	1977	Mannville C	15.6 °C.	function of depth 2500-3200 kPa	0.38-0.58		
10	1977				0.09-0.10 (wt.)		
13	1977					490	
14	1974/7		55 °F.	450 psi	0.515-0.55		initial GOR: 41.5 scf/STB
15	1978	Clearwater	55 °F.	440 psi	0.55		
16	1979	Clearwater	13 °C. (55 °F.)	3100 kPa (450 psig)			initial GOR: 9.8 m^3 (st)/m^3 (55 SCF/bbl)
18	1979		55 °F.	450 psi	0.60		
19	1979						initial GOR: 35 scf/bbl (6.23 m^3/m^3)
22	1981		15 °C. ?	2500 kPa	0.42		Yes
23	1981	Marguerite Lake	16 °C.	400 psi (2758 kPa)	0.67	702	pseudo-components
24	1981	Clearwater			0.14-0.16 (wt.)		
25	1981		65 °F.	473 psia			
26	1981						Yes

TABLE 5.1. A survey of commonly reported reservoir properties - Part 1 (cont.).

Ref.	Year	Formation	Temperature	Pressure	Hydrocarbon Saturation	Molecular Weight	Distillation data?
27	1981	Grand Rapids			0.76		
27	1981	Clearwater	55 ° F.	440 psig	0.73	490	Yes
27	1981	McMurray	50 ° F.		0.69		
29	1982	Clearwater	55 ° F.	440 psig	0.73	490	Yes
29	1982	Marguerite Lake	15 ° C. (59 ° F.)	2700 kPa (392 psi)			
30	1982	Clearwater	55-62 ° F.			490	
31	1983	Grand Rapids			0.76		
31	1983	Clearwater	13 ° C.	3030 kPa	0.73	490	Yes
31	1983	McMurray	10 ° C.		0.69		
32	1983		13 ° C.	3100 kPa	0.70		initial GOR: 9.8 $m^3(ST)/m^3$
35	1984	Beaver Crossing	60.0 ° F.	400 psia	0.77		
37	1984					500.4	
38	1984	Grand Rapids	13-21 ° C.		0.65-0.82		
38	1984	Clearwater	13-21 ° C.		0.64-0.65		
38	1984	Wabiskaw/ McMurray	14-26 ° C.		0.7-0.85		
39	1984	Lower Grand Rapids					

TABLE 5.1. A survey of commonly reported reservoir properties - Part 2.

Ref.	Formation	Porosity	Permeability	Density	$\mu_{initial}$	μ_{other}
1	Clearwater	0.395				
2	Upper Mannville	0.28-0.43 0.37 (avg.)	300-1300 mD up to 3000 mD	1000-986 kg/m^3 10-12 ° API		
3				10-12 ° API		4000-100,000 cp at 100 ° F.
4	Mannville C	0.37	$\leq$3000 mD	10-12 ° API	100,000 cp	graph
5		0.35	~1 D	10 ° API	100,000 cp	
6	Mannville	0.37	3000 mD	10-12 ° API	100,000 cp	graph
7	Cummings	0.38	4-14 D	10.5 ° API	~10^5 cp	graph?
8		0.36	k_A: 8000 mD k_y: 800 mD	62.14 lb./cu. ft.	100,000 cp	tabulated
9	Mannville C	0.30	k_A: 0-2.467$\times$10^{-12}m^2 k_y: 0-0.247$\times$10^{-12}m^2			
10		0.30-0.35				same graph as in Winestock [4]
11		0.35-0.45				
12		0.30-0.35		10-12 ° API		graph
14		0.285-0.385	795-1240 mD	62.3 lb./cu. ft.	100,000 cp	
15	Clearwater	0.37	$\leq$3000 mD	10-12 ° API	100,000 cp	same graph as as in Winestock [4]
16	Clearwater	0.35	1.5 D	10.2 ° API (998 kg/m^3 @15 ° C.)	100,000 cp	graph similar to the one in Winestock [4]
17						for 27.5-72.5 ° C. for various shear rates
18		0.35	1500 mD	10 ° API	100,000 cp	
20						graph
21		0.37 @138 kPa	2.86 μm^2	999.6 kg/m^3 @138 kPa, 23.9 ° C.	1.2$\times$10^3 Pa.s @23.9 ° C.	table up to 260 ° C.
22		0.30	> 1 μm^2	988 kg/m^3		17,600 mPa.s @21 ° C. 3,300 mPa.s @38 ° C. 650 mPa.s @60 ° C.
23	Marguerite Lake	0.21-0.31	0.55-1.70 D	1.41$\times$10^3 mol/m^3		formula
24	Clearwater	0.18-0.35				
25		0.3	500 mD	62 lbm./cu. ft.	200,000 cp	table
26				992 kgm/m^3		160 mPa.s @100 ° C.

TABLE 5.1. A survey of commonly reported reservoir properties - Part 2 (cont.).

Ref.	Formation	Porosity	Permeability	Density	$\mu_{initial}$	μ_{other}
27	Grand Rapids	0.34-0.40				
27	Clearwater	0.34-0.40?	≤3 D	10-12 ° API	100,000 cp	100 cp @212 ° F.
27	McMurray	0.38-0.46				
28		0.37	3000 mD	0.990-1.000 g/cm^3		100 cP (u.r.c.)
29	Clearwater	0.34-0.40	≤3000 mD	10-12 ° API	100,000 cp	100 cp @212 ° F.
29	Marguerite Lake	0.30				6800 mPa.s @38 ° C. 680 mPa.s @66 ° C. 130 mPa.s @96 ° C.
30	Clearwater			9.3 ° API 1.004 g/mL	1x10^5 cp	
31	Grand Rapids	0.34-0.40				
31	Clearwater	0.38-0.46	≤300 μm^2 [slc]	10-12 ° API (0.986-1.00)	100 Pa.s @15 ° C.	0.1 Pa.s @100 ° C.
31	McMurray	0.30-0.36				
32		0.35	1.5 D	10.2 ° API 0.9987	100 Pa.s	8x10^{-3} Pa.s @200 ° C.
33				for 20-90 ° C. e.g. 990 kg/m^3 @20 ° C.	400,000 mPa.s @21.1 ° C.	for 21.1-104.0 ° C. for various shear rates e.g. 60 mPa.s @104.0 ° C.
34				10.2 ° API		
35	Beaver Crossing	0.38	2500 mD	62.4 lbm/ft^3	200,000 cp	2.5 cp @600 ° F.
36						graph same as in Buckles [10]
38	Grand Rapids	0.28-0.35	1-4 D	985-1001 kg/m^3	0.5-1x10^5 mPa.s	
38	Clearwater	0.275-0.35	0.5-3 D	986-1000 kg/m^3	10^5 mPa.s	
38	Wabiskaw/ McMurray	0.32-0.33	1.5 D	994-1000 kg/m^3	10^4-10^5 mPa.s	
39	Lower Grand Rapids			10.2 ° API		44,500 cp @25 ° C. 13,800 cp @35 ° C.

Reasonably representative values of the initial conditions are

Temperature:	$14^{\circ}C.$
Pressure (at bottom):	3180 kPa
Vertical Pressure Gradient:	-9.8 kPa/m
Bitumen Saturation:	0.64
Vapour Saturation:	0.001
Gas-Bitumen Ratio:	9.8 m^3/m^3
	0.71% (wt.)

5.3 Reservoir Matrix Properties

In this section, we summarize the information concerning the reservoir properties which affect fluid-solid interactions.

5.3.1 Porosity

A summary of published values is given in table 5.1. Although a value of 0.37 appears to be most representative of the data, Dusseault[45] pointed out that many porosity measurements are in error because no allowance was made for disturbance during coring. In a later paper, Dusseault and Van Domselaar[40] recommended an average value of 0.31. This value is corroborated by a recent detailed survey by Reddy et al.[38], who reported a range of values between 0.275 and 0.35. Hence, a value of 0.31 appears to be the most reasonable choice for porosity.

5.3.2 Absolute Permeability

Table 5.1 provides a summary of the available data. There is considerable variation in the fines content of the sand from site to site, and, even in a single site, between the top and bottom of the pay. Hence, large variations in absolute permeability are to be expected. A value of 1.5×10^{-12} m^2 seems to be most representative.

5.3.3 Relative Permeability

Four authors have published data concerning the relative permeability in Cold lake. The endpoint data are tabulated in table 5.2. Once again, even with the small amount of data available, there is considerable variation. Weinstein et al.[14a] attributed their very low values of k_{rw} and k_{rg} to the formation of emulsions as the oil and water flow through the sand. The data of Coats[8], Settari and Raisbeck[25], and Duerksen et al.[35] are relatively consistent with one another, but the data in the latter two papers are incomplete.

Duerksen et al.[35] reported a significant dependence of the irreducible water saturation $S_{w,irr}$ on reservoir temperature. Such a strong dependence may have a significant effect on recovery performance.

Taking all factors into account, we recommend the use of the data of Coats[8], with one exception: our recommended value for $S_{g,crit}$ is 10^{-3}, not zero. For completeness, the relative permeability tables of Coats are reproduced in table 5.3.

5.3.4 Compressibility and Thermal Properties

The compressibility and thermal properties of the formation are given in table 5.4. There seems to be considerable disagreement concerning the rock compressibility, α_{rock}. However, Dusseault and Van Domselaar[40] have investigated the effect of different core sampling procedures on the measured values of this property, and report that the correct value lies in the range $0.2 - 0.8 \times 10^{-6}$/kPa. Hence, we have selected 0.5×10^{-6} as representative.

There is a general consensus that the thermal conductivity of the formation, k_f, is somewhat smaller than that for the overburden, k_{OB}. Duerksen et al.[35], however, report the opposite trend in their data. Finally, the values reported for rock and overburden heat capacity, $c_{p,r}$ and $c_{p,OB}$ are fairly consistent, except for Duerksen et al.

TABLE 5.2. Relative Permeability Data.

Author	Duerksen et al.[35]	Coats[8]	Weinstein et al.[14a]	Settari and Raisbeck[25]
$S_{w,irr}$ 60°F.	0.2	0.35	0.25	0.30
$S_{w,irr}$ 650°F.	0.5			
$S_{g,crit}$	0.0	0.0	0.025	--
$S_{or}(w)$	0.211	0.20	0.19	0.25
$S_{or}(g)$	0.09	?	?	--
k_{rw} at S_{or}	0.164	0.200	0.017	0.20
k_{ro} at $S_{w,irr}$	0.4	0.8	1.0	0.93
k_{rg} at s_{or}	0.18	0.2	0.023	--
absolute permeability ($10^{-12}m^2$)	2.5	8.0 (hors) 0.8 (vert)	0.8-1.2	0.5

TABLE 5.3. The relative permeability tables of Coats[8].

Water-Oil Relative-Permeability			Gas-Oil Relative-Permeability		
S_w	k_{rw}	k_{row}	$S_l=S_{wir}+S_o$	k_{rog}	k_{rg}
0.35	0	0.800	0.45	0.000	0.200
0.40	0.010	0.520	0.50	0.017	0.140
0.50	0.040	0.240	0.60	0.068	0.072
0.60	0.072	0.110	0.70	0.158	0.040
0.70	0.125	0.032	0.80	0.300	0.020
0.80	0.200	0.000	0.90	0.500	0.005
0.90	0.350	0.000	1.00	0.800	0.000
1.00	1.000	0.000			

TABLE 5.4. Miscellaneous bitumen and formation properties.

Author **	Compressibility		Thermal Expansion	Thermal Conductivity		Heat Capacity		
	α_{rock} $\left(\frac{10^{-6}}{kPa}\right)$	α_{sd} $\left(\frac{10^{-6}}{kPa}\right)$	β_{sd} $\left(\frac{10^{-4}}{K}\right)$	k_f $\left(\frac{W}{m \cdot K}\right)$	k_{OB} $\left(\frac{W}{m \cdot K}\right)$	$c_{p,o}$ $\left(\frac{kJ}{kg \cdot K}\right)$	$c_{p,r}$ $\left(\frac{kJ}{m^3 \cdot K}\right)$	$c_{p,OB}$ $\left(\frac{kJ}{m^3 \cdot K}\right)$
Coats[3]	0.6	1.5	9	2.77	2.77	2.1	2300	2300
Settari et al.[35]	7	–	5.2	1.63	2.52	2.04	2300	2500
Duerksen et al.[35]	18†	0.7	7.2	2.75	1.69	2.1	1250	2120
Weinstein et al.[14a]	15	–	–	1.73	2.42	–	2300	2700
recommended value	0.5	0.47‡	7	2	2.5	2.1	2300	2400

** The values in this table were converted from the foot-pound-second system to SI. This causes small inaccuracies in the actual values, and misrepresents slightly the implied precision of the numbers.

† This figure is the compressibility of the formation, not of the rock.

‡ This value is used by Butler[46].

5.4 Bitumen Properties

5.4.1 Compressibility and Thermal Properties

The bitumen compressibility and thermal properties are given in table 5.4. The compressibility of bitumen, α_{oil}, is poorly documented by the authors cited in the table. However, Butler[46] suggests a value of $0.47\times10^{-6}\ kPa^{-1}$. There is reasonable agreement on the coefficient of thermal expansion, β_{oil}, and the heat capacity $c_{p,o}$.

5.4.2 Density

Table 5.1 provides a summary of published data for the density of the bitumen at reservoir conditions. A value of 990 kg/m^3 appears to be most representative.

A graph of the density of Cold Lake bitumen as a function of temperature is given by Steinborn and Flock[33]. Unfortunately, their graph goes no further than 90^oC. Other authors simply assume that the density varies linearly with temperature and with pressure, and publish the relevant coefficients, namely α_{oil} and β_{oil} (see the summary in table 5.4). Because of the lack of data on the nonlinear variation of density with temperature (for temperatures larger than 90^oC.) and with pressure, we recommend using these coefficients to construct the formula

$$\rho = 990\,(1 - 7\times10^{-4}(T-T_{initial}) + 0.47\times10^{-9}(P-P_{initial}))$$

The density of the vapour phase may be calculated by regarding the vapour phase as an ideal solution (as defined, eg. by Denbigh[47]) of methane and steam. The density of the methane may be calculated using the ideal gas equation, and the density of the steam may be obtained from steam tables.

5.4.3 Viscosity

Table 5.1 provides a summary of published data. Although there are exceptions, the consensus is that the viscosity of the bitumen is 100 Pa.s at the initial reservoir temperature of $13^{\circ}C$. There is also a limited consensus regarding the viscosity as a function of temperature, as several publications[4,10,15,16,38] contain graphs, which are almost identical, and several other publications have either graphs or tabulated values, which are similar to the graph presented, e.g., by Winestock[4]. The curve on this graph may be fitted quite accurately, over the entire range of temperatures ($10-350^{\circ}C$.) of interest to us, by the equation

$$\log_{10}(\log_{10}(\mu_C)) = \frac{2150}{T+354} - 2.660 \qquad (5.01)$$

where μ_C is the viscosity of Cold Lake bitumen in centipoise (1 cp = 10^{-3} Pa.s), and T is the temperature in degrees Kelvin. It is interesting that the curve on the same graph for the viscosity of Athabasca bitumen can be fitted accurately by the equation

$$\log_{10}(\log_{10}(\mu_A)) = \frac{2150}{T+354} - 2.572$$

which is the same as the analogous equation for Cold Lake bitumen, except for a different constant.

It should be noted that there is considerable heterogeneity in the Cold Lake deposit, as Duerksen et al.[35], Reddy et al.[21], and Settari and Raisbeck[25] describe Cold Lake bitumens considerably more viscous than the one to which equation (5.01) applies. Nevertheless, the equation (5.01) for the viscosity of Cold Lake bitumen as a function of temperature may be taken as representative.

No data are available describing the effect of dissolved methane on the viscosity of Cold Lake bitumen. Perhaps, viscosity-composition-temperature correlations (e.g.[41,48]) valid for other oil sands deposits or heavy oil reservoirs might be adapted in order to describe the Cold Lake bitumen.

5.4.4 Molecular Weight

Table 5.1 shows that 490 is the most frequently used value for the average molecular weight of the bitumen.

5.4.5 Solubility of Methane in Bitumen

As is mentioned above, a methane gas-oil ratio of 9.8 $m^3(ST)/m^3$ was reported by Buckles[16], and by Mainland and Lo[32]. Lower values of 7.5 and 6.3 $m^3(ST)/m^3$ were reported by Weinstein et al.[14] and by Farouq-Ali[19] respectively. Since it is believed (see the viscosity-temperature graph of Winestock[4]) that the bitumen is saturated with methane at initial reservoir conditions, it is reasonable to take the largest reported gas-oil ratio, namely 9.8 $m^3(ST)/m^3$ (= 0.71% wt.) as the solubility of methane in Cold Lake bitumen at 13° *C.* and 3100 kPa.

Data for the solubility of methane in Cold Lake bitumen at other temperatures and pressures are not available. However, data for the solubility of methane in bitumen from other oil sands deposits are available [41–44], and may be used as a guide for estimating a tentative correlation for the Cold Lake bitumen. The data for the solubility of methane from the other oil sands deposits may be fitted to within a few percent by the following empirical correlations, which we have derived:

For Wabasca bitumen,

$$\log_{10}\left(\frac{\hat{x}_m}{P}\right) = -9.04 + \frac{110}{T} - 0.010\times10^{-6}\,P$$

where T is the temperature in degrees Kelvin, P is the pressure in Pa, and $\hat{x}_m$ is the weight-fraction solubility of methane given as an absolute fraction.

For Peace River bitumen (same units),

$$\log_{10}\left(\frac{\hat{x}_m}{P}\right) = -9.07 + \frac{120}{T} - 0.017\times10^{-6}\,P$$

For Athabasca bitumen (same units),

$$\log_{10}\left(\frac{\hat{x}_m}{P}\right) = -9.76 + \frac{270}{T}$$

(The third term was omitted because no systematic variation of $\log_{10}(\hat{x}_m/P)$ with P was observed; only scatter was observed).

The average percentage discrepancies between these correlations and the experimental values were calculated. Two of the 58 reported values were omitted because a blatant inconsistency between the reported weight-percent solubility and the reported volume-percent solubility was observed. Thus, the average percentage discrepancy is 3.8% for the Wabasca correlation, based on 12 points; 2.5% for the Peace River correlation, based on 15 points; and 8.9% for the Athabasca correlation, based on 29 points.

Mehrotra and Svrcek[41] give a 4-parameter correlation for the solubility of methane and other gases, but this correlation applies only to the Athabasca bitumen which, of the three bitumens, is the most different from Cold Lake bitumen. The average discrepancy of their correlation (for methane only) is 9.3%, based on 29 points (9.7%, based on 30 points, if the inconsistent set of values is not omitted). Thus, the discrepancy of our 3-parameter correlation (which can even be considered to be a 2-parameter correlation for the Athabasca bitumen) is slightly better than the discrepancy of their 4-parameter correlation.

When the initial conditions of the Cold Lake reservoir (as reported by Buckles[18]) are substituted into these three correlations, the following solubility predictions are obtained: the Wabasca correlation predicts 0.64% (wt.), the Peace River correlation predicts 0.61%, and the Athabasca correlation predicts 0.47%. This indicates that the methane is more soluble in Cold Lake bitumen than in any of the other bitumens, and that the Wabasca bitumen is the most similar to Cold Lake bitumen with regard to methane solubility. Therefore, it was decided to adapt the Wabasca correlation to the Cold Lake bitumen by modifying the constant in order to fit the one observed solubility. Hence, for Cold Lake bitumen,

$$\log_{10}\left(\frac{\hat{x}_m}{P}\right) = -9.00 + \frac{110}{T} - 0.010\times10^{-6}\,P \qquad (5.02)$$

At T=286.15°K., P=3.10×10^{-6} Pa, this correlation predicts a solubility of 0.70% (wt.), which is close enough to what was observed.

This correlation should be regarded as a tentative estimate, until direct experimental data become available.

To obtain an explicit formula for the vapour pressure as a function of T and $\hat{x}_m$, take 10 to the power of both sides of equation (5.02), make the substitution

$$P^* = (\ln 10)\,0.010 \times 10^{-6}\,P \tag{5.03}$$

and rearrange:

$$P^* e^{-P^*} = \hat{x}_m\left((\ln 10)\,0.010 \times 10^{-6}\right) 10^{9.00 - \frac{110}{T}} \equiv G_2 \tag{5.04}$$

Then the solution P^* is given by

$$P^* = G_2 + G_2^2 + (3/2)G_2^3 + (8/3)G_2^4 + \cdots \tag{5.05}$$

with G_2 defined as in equation (5.04). Equation (5.03) then gives the vapour pressure P.

5.4.6 Enthalpy of Solution of Methane

The enthalpy of solution of methane in bitumen may be calculated from the vapour pressure equation (5.02) using the thermodynamic relation[49]

$$h_m^g - H_m = RT^2 \left(\frac{\partial \ln(p_m/x_m)}{\partial T} \right)_P \tag{5.06}$$

where $h_m^g - H_m$ is the enthalpy of solution of the methane, p_m is the vapour pressure of the methane, and P is the total pressure. Although p_m does not equal P in the reservoir, (since the vapour pressure of the water is significant), p_m and P were equal during the solubility measurements from which equation (5.02) was obtained. Therefore, equation (5.06) may be rewritten as

$$h_m^g - H_m = RT^2 \left(\frac{\partial \ln(P/x_m)}{\partial T} \right)_P = -RT^2 \left(\frac{\partial \ln(x_m)}{\partial T} \right)_P \tag{5.07}$$

Since the volatile component #2 is absent, the mole fraction and mass fraction of methane in bitumen are related by

$$\hat{x}_m = \frac{x_m(MW_m/MW_b)}{1 - x_m(1 - (MW_m/MW_b))}$$

Therefore, a long derivation shows that

$$\left(\frac{\partial \ln(x_m)}{\partial T} \right)_P = \left(1 - x_m(1 - (MW_m/MW_b))\right) \left(\frac{\partial \ln(\hat{x}_m)}{\partial T} \right)_P \tag{5.08}$$

The last partial derivative in equation (5.08) can be computed from the vapour pressure equation (5.02)

$$\left[\frac{\partial \ln(\hat{x}_m)}{\partial T}\right]_P = (\ln 10)\left[\frac{\partial \log_{10}(\hat{x}_m/P)}{\partial T}\right]_P = \frac{(\ln 10)(-110)}{T^2} \qquad (5.09)$$

Equations (5.07), (5.08), and (5.09) together imply that

$$h_m^g - H_m = [1 - x_m(1 - (MW_m/MW_b))]\, R\,(\ln 10)(110) \qquad (5.10)$$

Thus, the heat of solution of methane in bitumen is approximately 2×10^6 J/kmole, compared with 41×10^6 J/kmole for the latent heat of condensation of steam.

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6. RESULTS AND PROPOSED EXTENSIONS OF THE COORDINATE TRANSFORMATION PROCEDURE

6.1 Results

A great deal of effort went into the implementation of the equations which are derived and discussed in chapters 2, 3, and 4. Many of the detailed considerations required in the numerical algorithm are, by necessity, glossed over in the text of this report. The resulting computer program contains a total of approximately 6300 FORTRAN statements (excluding comments). The source code listing and a set of sample data are available as a separate appendix volume to this report. The process of debugging and checking the simulator was very time-consuming, and was assisted by a qualitative comparison with the expected behaviour.

In order to illustrate the capabilities and limitations of the simulator, we ran it for the following test case. The grid is 8x7, with θ values chosen as $-180°$, $-135°$, $-90°$, $-45°$, $0°$, $45°$, $90°$, and $135°$, and r values chosen as 0.0, 0.8, 1.0, 1.0, 1.08, 1.22, and 4.02 (dimensionless). The radii of the steam chamber at these values of θ were chosen to be 1.20, 1.10, 1.00, 1.10, 1.20, 1.10, 1.00, and 1.10 metres, respectively. The pressure was chosen to be 7.50 MPa everywhere (including the production well) except at the injection well, where it was chosen to be 7.80 MPa. The temperature was chosen to be the steam equilibrium temperature inside the steam chamber and at its boundary, 160°C. at the $r = 1.08$ grid points, and 14°C. in the rest of the reservoir outside the steam chamber, except that at the production well, the temperature was chosen to be 200°C. The phase saturations S_g, S_w, S_o were chosen to be (0.710, 0.200, 0.090) in the interior of the steam chamber, (0.100, 0.250, 0.650) at the steam front on its inner side, and (0.001, 0.359, 0.640) outside the steam chamber even up to the outer side of the steam front. The mole fractions of methane and light oil in the bitumen were taken to be zero everywhere. Finally, the injection and production wells were placed at (X,Y) = (0.00,0.80) and (0.00,-1.40) respectively. Therefore, initially, until the steam front moves a significant distance, the injection well is taken to be at the ($\theta = 90°, r = 0.80$) grid

point, and the production well is taken to be at the ($\theta = -90^{\circ}, r = 1.22$) grid point. With few exceptions, the reservoir and material properties are as listed in chapter 5 of this report. The viscosity of the bitumen was modified by the viscosity modification factors of Coats[1]. Also, the water-phase and vapour-phase viscosities, and the relative permeabilities and endpoint data were taken from Coats's 1978 paper[1] instead of from his 1976 paper[2].

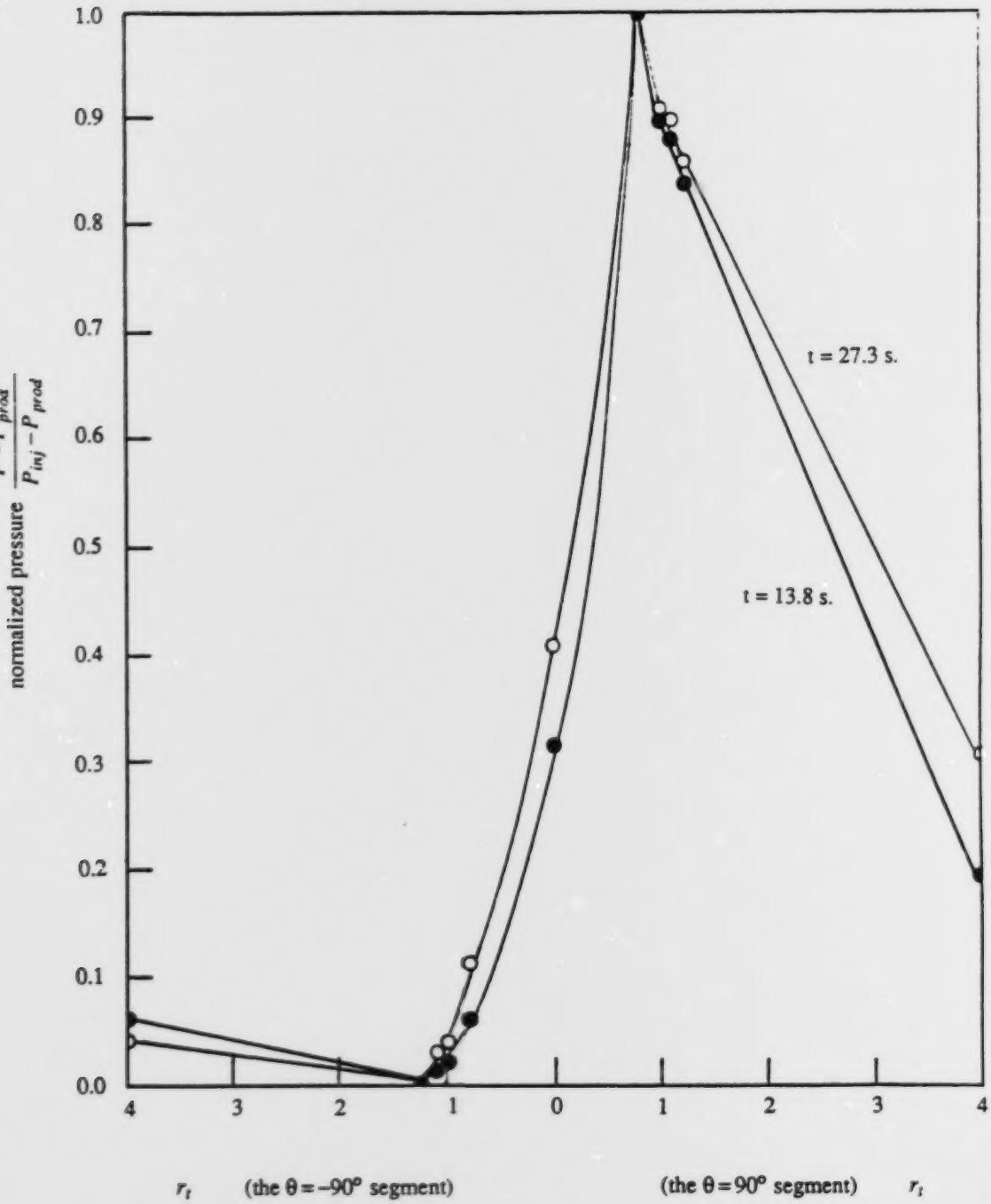
The simulator ran for 46 time steps, which represented 29.3 seconds of reservoir time, printed results for 44 time steps, which represented 27.3 seconds of reservoir time, and required almost 1000 seconds of CPU time on the Cray X/MP computer at the University of Toronto. Thus, the simulator is extremely slow. This problem is discussed in more detail below.

Figure 6.1 shows pressure profiles along the $\theta = \pm 90^{\circ}$ cross-section through the reservoir. The dimensionless pressure is 1.0 at the injection well and 0.0 at the production well. During the first 27 seconds, the pressure is relaxing from the initial conditions towards a quasi-steady-state pressure profile.

Figure 6.2 displays the volumetric flow rates out of the injection well and into the production well. Clearly, after 27 seconds of reservoir time, these flow rates have not yet relaxed to their quasi-steady-state values. Because the injected fluid is steam whereas the produced fluids are liquid, it is to be expected that the volumetric injection rate should exceed the volumetric production rate, not only during the initial transient, but also after the quasi-steady-state is attained.

Figure 6.3 describes the motion of the steam front during the initial transient period. Although there are eight front locations, one for each of the eight directions, only five of the eight are shown, because the other three front locations are equivalent by symmetry to three of the five front locations shown in figure 6.3. At the ceiling, the steam front is advancing, whereas in the other directions, the steam front is retreating. Since buoyancy forces tend to push the steam chamber up like an air bubble in water, it is reasonable to expect the steam front, at the ceiling of the steam chamber, to advance upward. The steam front is retreating everywhere except at the ceiling of the steam chamber, but is retreating most quickly at points near the ceiling. Therefore, figure 6.3 suggests that the condensate from the ceiling of the steam chamber flows down the sides of the steam chamber.

FIGURE 6.1 - Normalized pressure profiles along a vertical cross-section ($\theta = \pm 90°$) through the steam chamber.



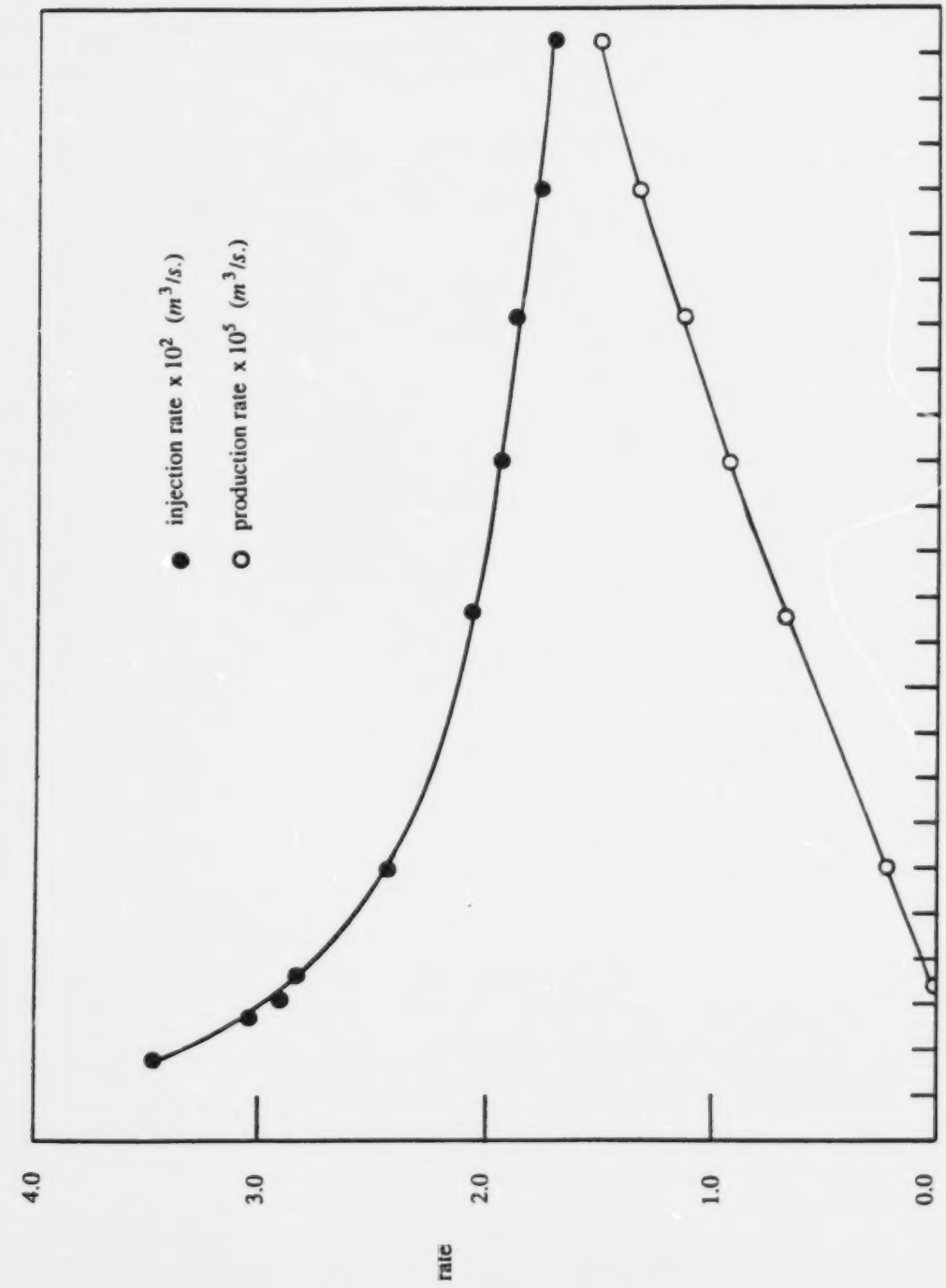
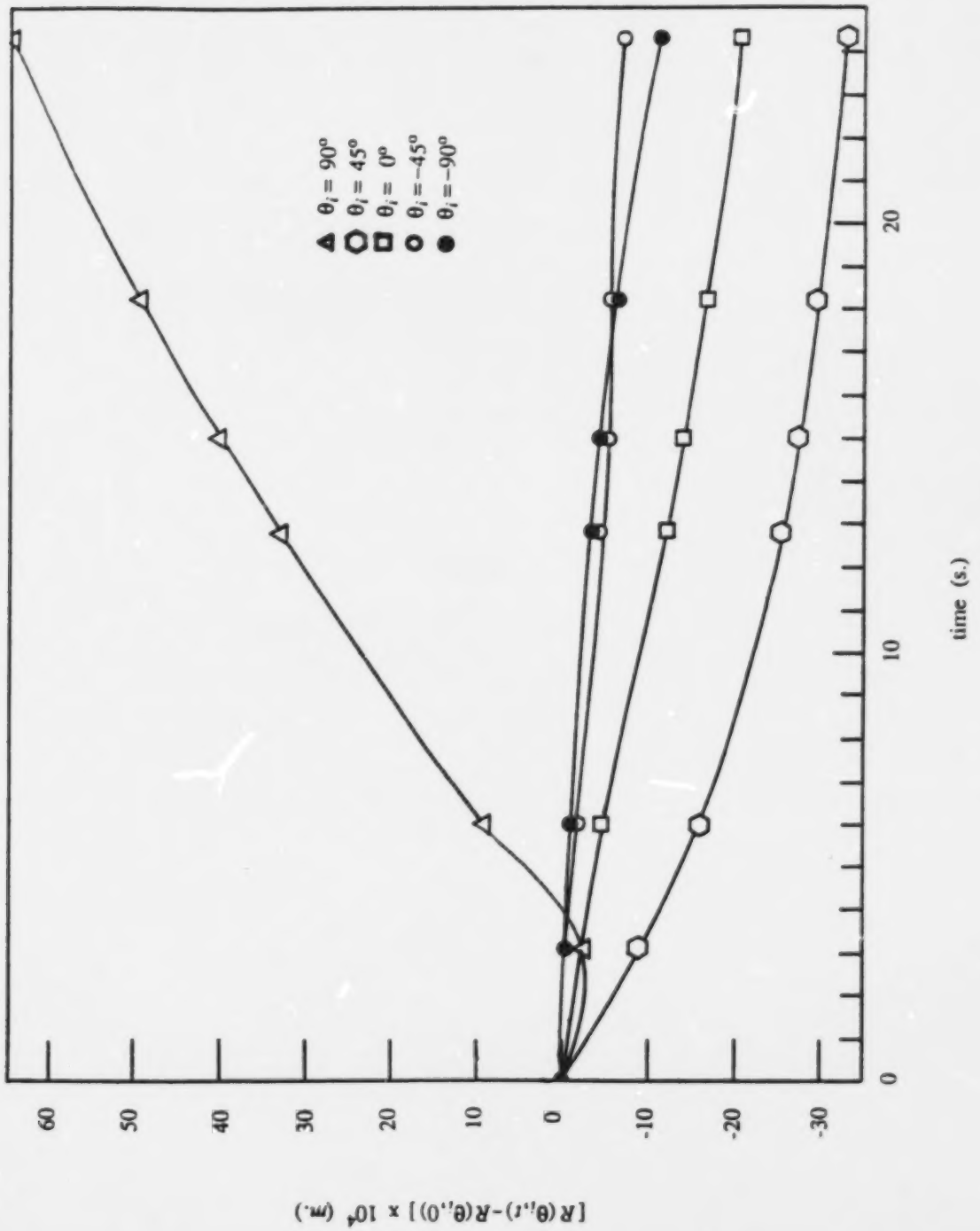


FIGURE 6.2 - Volumetric injection and production rates as a function of time.

FIGURE 6.3 - Motion of the steam front as a function of time.



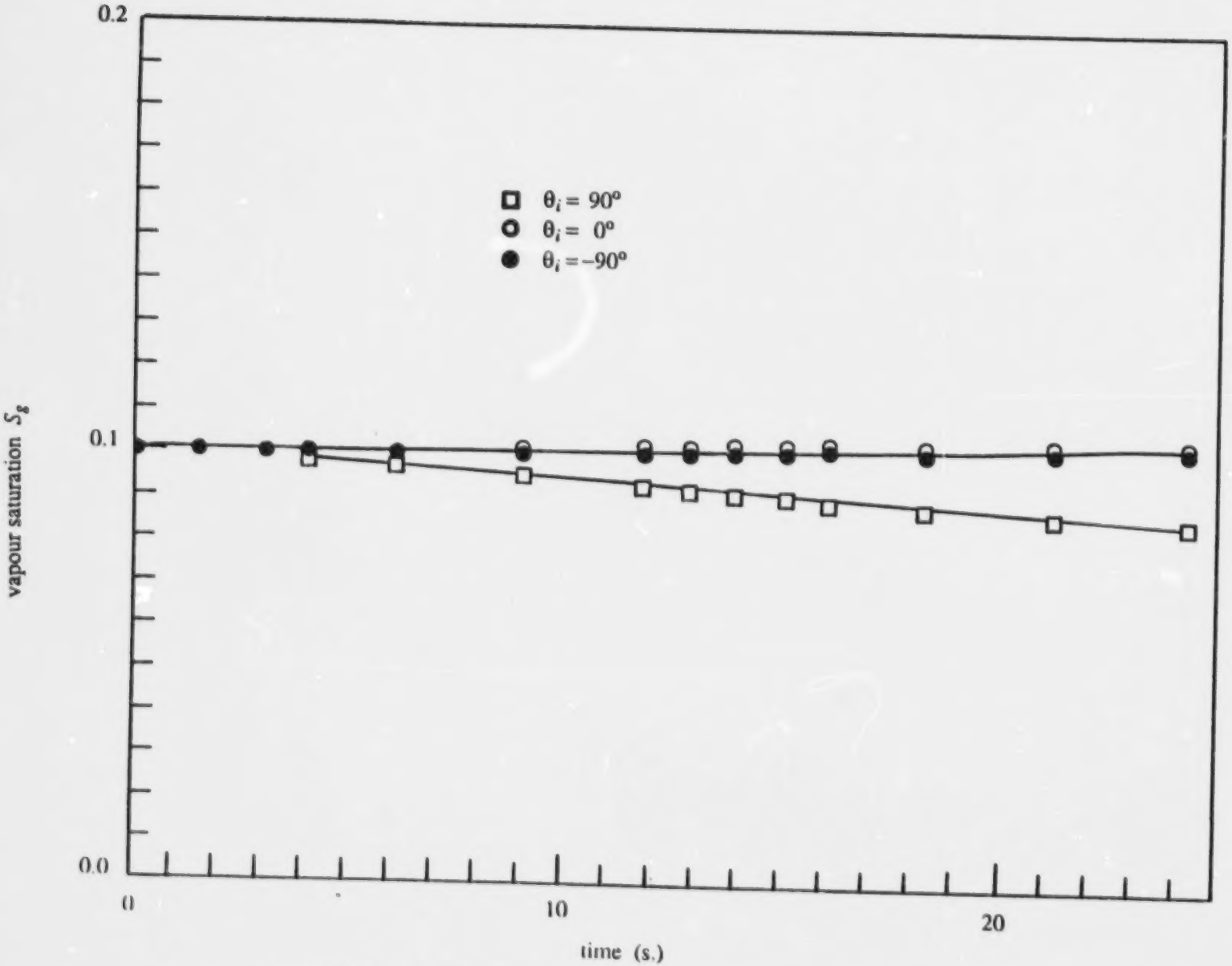


FIGURE 6.4 - Vapour saturations at the steam front as a function of time for the 8 x 7 grid.

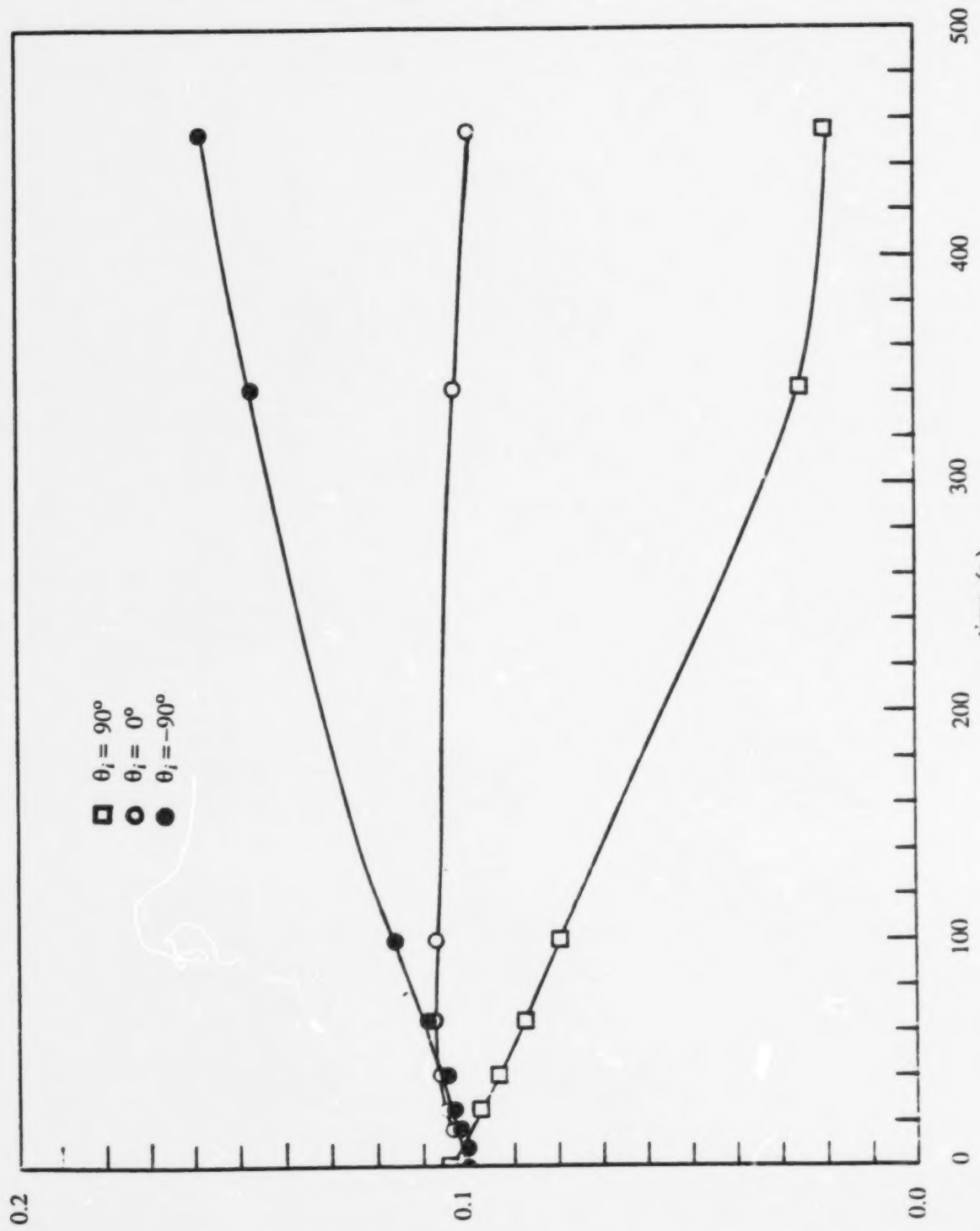


FIGURE 6.5 - Vapour saturations at the steam front as a function of time for the 4 x 6 grid.

Figures 6.4 and 6.5 illustrate the main limitation of the simulator. Figure 6.4 contains graphs of the vapour saturations at the grid points on the inner side of the steam front. The vapour saturations at the sides and floor of the steam chamber change very slowly during the initial 27 seconds, but the vapour saturation at the ceiling of the steam chamber decreases rather significantly. An indication of what would be expected to happen, if the simulator were run further at the expense of yet more Cray X/MP CPU time, may be obtained from a simulation which was run on a coarser grid with four values of θ: $-180°$, $-90°$, $0°$, $90°$, and six values of r: 0.00, 0.80, 1.00, 1.00, 1.20, 4.00. (Also, the location of the production well was taken to be (0.00,-1.80) instead of (0.00,-1.40), and its temperature was taken to be $60°C.$ instead of $200°C.$) The vapour saturation at the ceiling of the steam chamber steadily decreases until it reaches the residual value of 10^{-3}, after roughly 7½ minutes of reservoir time. This behaviour seems physically unrealistic, even though it has been suggested[3] that the ceiling of the steam chamber is physically unstable. Whether or not this rapid decrease in the vapour saturation is physically realistic, it presents problems for the simulator since the calculation of the steam front velocity depends on the existence of a discontinuity in vapour saturation at the front. This discontinuity disappears as the vapour saturation drops to its residual value. Since the Jacobian matrix of the nonlinear equations which govern the steam front movement becomes almost singular as this discontinuity disappears, the simulator encounters difficulties converging to the solution. The simulator then proceeds only with extremely tiny time steps.

When a similar saturation was attempted, in which the mole fraction of dissolved methane was taken to be 0.163 instead of zero, the simulator failed to converge. Although this problem, at first sight, appears to be unrelated to the problem with the declining vapour saturation at the ceiling of the steam chamber, the available evidence, as described in the following paragraphs, suggests that these two problems have a common origin.

The problem appears to be with our model of the steam front. We assumed that the steam front could be defined as a discontinuity, at which the vapour saturation is zero on one side, and large on the other side, and that the finite-difference approximation to the transport equations and matching conditions would generate a reasonable approximate solution for the vapour saturation at the

discontinuity. This model was adequate for the walls and floor of the steam chamber, where the steam on the one side of the steam front and the liquid on the other side of the steam front can be considered to be pushing against each other. However, at the ceiling, significant countercurrent flow occurs, with steam moving up and liquid moving down through each other, instead of pushing against each other. Therefore, it is possible for two saturation fronts to travel in opposite directions. The simulator can handle countercurrent flow, but was never designed to handle two saturation fronts travelling in opposite directions.

This difficulty has two consequences. First, the simulator has considerable difficulty deciding which direction the steam front is moving. Second, because of the unrealistic description of what is happening at the ceiling, the simulator apparently overestimates the velocity of the steam front, once it decides that the steam front is moving upward. Because the steam flow in the steam chamber cannot keep pace with the steam front, the vapour saturation at the steam front consequently drops, and quickly drops to the irreducible vapour saturation.

The problem with our steam front model at the ceiling of the steam chamber is related also to the slowness of the simulator. One of the reasons why the simulator requires so much computer time is because it converges too slowly (roughly 15 iterations per time step, on average, whereas 3-4 iterations per time step was expected). Not only do the extra iterations require extra computer time, but they also cause the simulator to use much smaller time steps than it would otherwise use. Furthermore, the problematic convergence makes it unfeasible to save computer time by calculating an approximate Jacobian matrix instead of an exact Jacobian matrix. A detailed study of the convergence behaviour indicates that the slow convergence may be attributed largely to the difficulty in deciding which direction the steam front is moving at the ceiling of the steam chamber. Therefore, a better steam front model would almost certainly lead to a much faster simulator.

The problem with our steam front model at the ceiling of the steam chamber is likewise related to the failure of the simulator to converge when the mole fraction of methane in the bitumen is 0.163, since the same problems which cause the simulator to converge slowly when the methane mole fraction is zero cause a complete convergence failure when the methane mole fraction is 0.163. Therefore, a better

steam front model should enable the simulator to handle compositional simulations.

6.2 The Proposed Modifications to the 2-D Simulator

6.2.1 Motivation: The Buckley-Leverett Problem

Due to the failure of the present formulation to properly simulate the development of the steam chamber, we have continued our analytical analysis of the front-movement problem. As a first step, we analyzed the use of our coordinate transformation method to solve the simpler well-known Buckley-Leverett problem, to be described below. We discovered that a computer implementation of our coordinate transformation method would have the same type of difficulty handling even the simple Buckley-Leverett problem, but that this difficulty could be overcome (for the Buckley-Leverett problem) if a simple modification was made to our coordinate transformation method. We propose to pursue this analogy further, in order to derive a modification appropriate for the more complicated system of equations (2.1) and (2.2).

The standard equations for two-phase flow in one dimension are

$$\phi \frac{\partial S_w}{\partial t} = \frac{\partial}{\partial X}\left[\lambda_w(S_w)\frac{\partial P}{\partial X}\right] \tag{6.01}$$

$$\phi \frac{\partial (1-S_w)}{\partial t} = \frac{\partial}{\partial X}\left[\lambda_o(S_w)\frac{\partial P}{\partial X}\right] \tag{6.02}$$

with boundary/initial conditions

$$S_w(X, t=0) = S_{w0} \quad , \quad S_w(X=0, t) = S_{wf} \tag{6.03}$$

for the saturations, and boundary conditions

$$P(X=0, t) = P_L \quad , \quad P(X=L, t) = P_R \tag{6.04}$$

for the pressure. Equations (6.01) and (6.02) can be transformed into the more familiar Buckley-Leverett form[4,5]

$$\phi \frac{\partial S_w}{\partial t} = -Q_T \frac{\partial}{\partial X}(f_w(S_w)) \tag{6.05}$$

$$f_w(S_w) = \frac{\lambda_w(S_w)}{\lambda_w(S_w)+\lambda_o(S_w)} \tag{6.06}$$

with equations (6.03) (but not (6.04)) as the boundary/initial conditions. In equations (6.01) through (6.06), $\lambda_w(S_w)$ and $\lambda_o(S_w)$ are to be interpreted as given functions, obtained from experimental measurements, or from a simplified model (which ultimately also is obtained from experimental measurements). Given $\lambda_w(S_w)$ and $\lambda_o(S_w)$, f may be calculated.

A graph of a typical $f_w(S_w)$ function appears in figure 2 of the paper by Buckley and Leverett[4]. If this $f_w(S_w)$ function is substituted into equation (6.05), then (6.05) has no solution in the rigorous sense in which mathematicians define the term "solution". (If a function has even a single discontinuity, that discontinuity disqualifies the function from being considered as a solution, even if the function satisfies the differential equation everywhere else.) On the other hand, (6.05) does have an infinite number of weak solutions, i.e. functions which satisfy (6.05) for those values of t and X where the function S_w is continuous and differentiable, and which satisfy the matching condition

$$\phi(S_{wf-}-S_{wf+})V_f = Q_T(f_w(S_{wf-})-f_w(S_{wf+})) \tag{6.07}$$

for every value of t and X where S_w is not continuous and differentiable, e.g. at the moving front.

Of these infinite number of weak solutions, only one is physically realistic. Typically, the physically realistic solution has precisely one discontinuity in the saturation, i.e. at the moving front, and this discontinuity moves in the positive X direction. The physical interpretation of this discontinuity is that a plug of water, with a well-defined boundary, advances through the reservoir, displacing the oil without smearing the oil-water interface.

The problem, then, is to generate a reasonable approximation to the one physically realistic solution among the infinite number of mathematical solutions to equations (6.05), (6.07), and (6.03), and to do so using a method which a) is computationally practical, and b) can be extended to the system of equations (2.1) and (2.2). For example, the well-known dissipation-tends-to-zero method is not computationally practical. Neither is the use of the generalized entropy conditions which also have been frequently discussed[6]. The finite-difference method, on the other

hand, has an inherent (but not inerrant) tendency to generate a physically realistic approximation (because it filters out the spikes and some of the steep gradients possessed by the physically unrealistic solutions), and is computationally practical, but we have seen above that the finite-difference method, as we have applied it to the system of equations (2.1) and (2.2), has problems handling the ceiling of the steam chamber.

To gain a better understanding of the problem, consider the use of our coordinate transformation method to solve the simpler equations (6.05), (6.07), and (6.03). The transformation

$$X = rR(t) \tag{6.08}$$

where $R(t)$ is the distance of the saturation discontinuity from the injection point, is used to fix the discontinuity at $r=1$, and to transform equation (6.05) to

$$\phi \frac{\partial S_w}{\partial t} = \frac{\phi V_f}{R(t)} r \frac{\partial S_w}{\partial r} - \frac{Q_T}{R(t)} \frac{\partial}{\partial r}(f_w(S_w)) \tag{6.09}$$

Next, a set of grid points $\{r_i\}$, including $r_{N_f}=1$, is defined, and equation (6.09) is discretized,

$$\phi \frac{(S_w)_i^n - (S_w)_i^{n-1}}{\delta t} = \text{spatially discretized terms} \tag{6.10}$$

For each ordinary grid point, there is one unknown, namely $(S_w)_i \equiv S_w(r_i)$, and one finite-difference equation which contains the discretized time-derivative of the unknown $(S_w)_i$. This finite-difference equation is coupled to the analogous finite-difference equations for $(S_w)_{i+1}$ and $(S_w)_{i-1}$ via discretized space-derivative terms. At the interface, on the other hand, there are three unknowns, $S_w|_{r=1-}$, $S_w|_{r=1+}$, and $R(t)$, and, at first sight, three finite-difference equations containing the discretized time-derivatives of these three unknowns. Of these three equations, one contains the discretized time-derivative of $(S_w)_{N_f-}$, one contains the discretized time-derivative of $(S_w)_{N_f+}$, and the third is the discretized version of the matching condition (6.07). The trouble with these three equations is that any reasonable finite-difference approximation for the r-derivatives cannot use values of S_w on both sides of the discontinuity, precisely because of the discontinuity. Thus, the only equation which expresses a coupling between $(S_w)_{N_f+}$ and $(S_w)_{N_f-}$ is the discretized

matching condition. Unfortunately, the discretized matching condition is also the only equation which expresses a real constraint on $R(t)$. Thus, although superficially the number of finite-difference equations equals the number of unknowns, in fact part of the system of equations is underdetermined. What is needed is a second equation coupling $(S_w)_{N_t-}$ and $(S_w)_{N_t+}$. Therefore, we conclude that the finite-difference method, without this additional equation, cannot select a reasonable solution out of the infinite number of mathematically weak solutions.

Given these difficulties, it is worthwhile to examine more carefully how Buckley and Leverett[4] and Welge[5] managed to obtain a unique solution to equation (6.05). Buckley and Leverett recognized that for a reasonable choice of the $f(S_w)$ function, the solution has a discontinuity, whose location as a function of time must be determined. They determined the location of the discontinuity, and hence S_{wf-}, by [7] "a material balance, the shaded area between the original and the new saturation curve being equal to $\frac{Q_1}{A}$ ".

Welge[5] proposed a more useful interpretation of this construction. Instead of relating S_{wf-} to the properties of the entire reservoir upstream from the discontinuity, Welge showed how to calculate S_{wf-} from S_{wf+}, using only properties of the $f_w(S_w)$ function. Welge's two graphical constructions (which he recognized to be equivalent to each other) are equivalent, respectively, to the following equations for S_{wf-}

$$\int_{S_{wf+}}^{S_{wf-}} \left\{ f_w'(S_w) - f_w'(S_{wf-}) \right\} dS_w = 0 \tag{6.11}$$

and

$$\frac{f_w(S_{wf-}) - f_w(S_{wf+})}{S_{wf-} - S_{wf+}} = f_w'(S_{wf-}) \tag{6.12}$$

(To show that (6.11) and (6.12) are equivalent is merely an exercise in calculus.)

Equation (6.12) has a useful interpretation in terms of the method of characteristics, a well-known method[8] for solving certain partial differential equations. Since the method of characteristics applied to equation (6.05) yields the expression

$$(V)_{S_{wf-}} = \frac{Q_T}{\phi} f_w'(S_{wf-}) \tag{6.13}$$

for the velocity $(V)_{S_{wf}}$ of the characteristic immediately upstream from the front, and since equation (6.07) may be rearranged as

$$V_f = \frac{Q_T}{\phi} \frac{f_w(S_{wf-}) - f_w(S_{wf+})}{S_{wf-} - S_{wf+}} \tag{6.14}$$

it follows from (6.12), (6.13), and (6.14) that

$$V_f = (V)_{S_{wf}} \tag{6.15}$$

Thus, equation (6.12) has the interpretation that the velocity of the front equals the velocity of the characteristic immediately upstream from the front.

Recall that we concluded above that a second equation coupling $(S_w)_{N_f}$ and $(S_w)_{N_f-}$ is what is needed in order to make our coordinate transformation method able to solve equation (6.10) with (6.03) and (6.07). We propose that equation (6.12) precisely satisfies this requirement and should be added to our system, replacing the $i = N_f -$ finite-difference equation (6.10).

Equation (6.12) disagrees with the entropy condition expounded by Lax[6]. This contradiction can be resolved because the entropy condition in Lax's monograph is based on the assumption that the f_w function is convex, i.e. it has no inflection point, whereas equation (6.12) is based on the assumption that the f_w function has at least one inflection point, a reasonable assumption for reservoir simulation problems. Indeed, the generalized entropy condition in the same monograph by Lax, which does not depend on any assumptions regarding the number of inflection points of the f_w function, does agree with equation (6.12).

6.2.2 Generalizations for the Steam Injection Problem

Now that it has been shown how to modify our coordinate transformation method, through the use of the method of characteristics, so that it can handle the Buckley-Leverett equation (6.05), let us consider how to extend this modification by analogy to modify the steam injection simulator so that it can generate an acceptable approximate solution to the system of equations (2.1) and (2.2). The equations (2.1) and (2.2) are more complicated than the Buckley-Leverett equation because of the following extra features: (a) gravity; (b) three-phase flow instead of two-phase flow; (c) two spatial dimensions instead of one; (d) a heat equation; (e) more than

one component in the oil phase. We have figured out how to generalize the modified coordinate transformation method to account for (a), (b) and (c), and anticipate being able to generalize for features (d) and (e) as well. These generalizations are analogous to generalizations of the method of characteristics, which appear scattered[9] throughout the literature.

The idea of using the method of characteristics as a building-block for a numerical method for calculating fluid flow is not new. References 9, 12, 13, 15, 16, and 18 of chapter 1 of this report are some of the many articles which at least refer to this idea. On the other hand, the combination, presented in this chapter, of the method of characteristics with a coordinate transformation method has not been published anywhere, as far as we know.

6.2.2.1 Gravity

If gravity is added to the model, then equations (6.01) and (6.02) must be modified by adding a gravity term

$$\phi \frac{\partial S_w}{\partial t} = \frac{\partial}{\partial X}\left[\lambda_w(S_w)\left(\frac{\partial P}{\partial X} - \rho_w g\right)\right] \tag{6.16}$$

$$\phi \frac{\partial (1-S_w)}{\partial t} = \frac{\partial}{\partial X}\left[\lambda_o(S_w)\left(\frac{\partial P}{\partial X} - \rho_o g\right)\right] \tag{6.17}$$

By eliminating the pressure term, one can derive a single equation

$$\phi \frac{\partial S_w}{\partial t} = \frac{\partial}{\partial X}\left[-f_w Q_T + \frac{\lambda_w \lambda_o}{\lambda_w + \lambda_o}(\rho_o - \rho_w) g\right] \tag{6.18}$$

which is a generalization of equation (6.05). Equation (6.12) may then be used, with $f_w(S_w)$ replaced by

$$f_w(S_w) - \frac{(\rho_o - \rho_g) g}{Q_T} \frac{\lambda_w(S_w)\lambda_o(S_w)}{\lambda_w(S_w) + \lambda_o(S_w)}$$

Although Q_T is not known a priori, and cannot be eliminated from (6.18) by scaling (it can be eliminated from equation (6.05) by scaling), that does not matter because a finite-difference approximation for Q_T can be used.

6.2.2.2 3-Phase Flow

The three-phase flow equations are analogous to (6.16) and (6.17)

$$\phi \frac{\partial S_w}{\partial t} = \frac{\partial}{\partial X}\left[\lambda_w(S_w,S_g)\left(\frac{\partial P}{\partial X} - \rho_w g\right)\right] \tag{6.19}$$

$$\phi \frac{\partial S_g}{\partial t} = \frac{\partial}{\partial X}\left[\lambda_g(S_w,S_g)\left(\frac{\partial P}{\partial X} - \rho_g g\right)\right] \tag{6.20}$$

$$\phi \frac{\partial (1-S_w-S_g)}{\partial t} = \frac{\partial}{\partial X}\left[\lambda_o(S_w,S_g)\left(\frac{\partial P}{\partial X} - \rho_o g\right)\right] \tag{6.21}$$

Via elimination of the $\partial P/\partial X$ term, this system may be reduced to a system of two equations

$$\phi \frac{\partial S_w}{\partial t} = \frac{\partial}{\partial X}\left[-Q_T \frac{\lambda_w}{\lambda_w+\lambda_g+\lambda_o} + (\rho_g-\rho_w)g \frac{\lambda_w\lambda_g}{\lambda_w+\lambda_g+\lambda_o} + (\rho_o-\rho_w)g \frac{\lambda_w\lambda_o}{\lambda_w+\lambda_g+\lambda_o}\right] \tag{6.22}$$

$$\phi \frac{\partial S_g}{\partial t} = \frac{\partial}{\partial X}\left[-Q_T \frac{\lambda_g}{\lambda_w+\lambda_g+\lambda_o} + (\rho_o-\rho_g)g \frac{\lambda_g\lambda_o}{\lambda_w+\lambda_g+\lambda_o} + (\rho_w-\rho_g)g \frac{\lambda_g\lambda_w}{\lambda_w+\lambda_g+\lambda_o}\right] \tag{6.23}$$

where ϕ, Q_T, the ρ_p, and g are approximately constant, and the λ_p are functions of S_w and S_g (and hence of X). According to the method of characteristics, the pair of equations (6.22) and (6.23) has, in general, two unequal characteristic velocities. Thus, the appropriate generalization of equation (6.15) is an equation equating the velocity of the front with the velocity, on the upstream side, of one of the characteristic velocities. We have not yet identified the criterion by which the appropriate velocity (of the two possibilities) should be selected.

6.2.2.3 Two Spatial Dimensions

Two generalizations of the method of characteristics are well-known. One generalization is for a single partial differential equation with an arbitrary number of independent variables. The other generalization is for a system of coupled partial differential equations of arbitrary size, but with only two independent variables, one of which may be time. The generalization which we need, namely one which handles a system of two partial differential equations with three independent variables t, X, Y is much less well-known, but is described by Sauer[10] and by Jeffrey and Taniuti[11].

Sauer considers the system of equations (he uses z instead of t)

$$a_{11}\frac{\partial u}{\partial X}+a_{12}\frac{\partial v}{\partial X}+b_{11}\frac{\partial u}{\partial Y}+b_{12}\frac{\partial v}{\partial Y}+c_{11}\frac{\partial u}{\partial t}+c_{12}\frac{\partial v}{\partial t}=h_1 \tag{6.24}$$

$$a_{21}\frac{\partial u}{\partial X}+a_{22}\frac{\partial v}{\partial X}+b_{21}\frac{\partial u}{\partial Y}+b_{22}\frac{\partial v}{\partial Y}+c_{21}\frac{\partial u}{\partial t}+c_{22}\frac{\partial v}{\partial t}=h_2 \tag{6.25}$$

and derives an equation for the characteristic inverse velocities

$$p=\left(\frac{\partial t}{\partial X}\right)_Y, \qquad q=\left(\frac{\partial t}{\partial Y}\right)_X \tag{6.26}$$

namely

$$R=\begin{vmatrix} a_{11}p+b_{11}q-c_{11} & a_{12}p+b_{12}q-c_{12} \\ a_{21}p+b_{21}q-c_{21} & a_{22}p+b_{22}q-c_{22} \end{vmatrix}=0 \tag{6.27}$$

Equation (6.27) is only one equation for the two unknowns p and q. A second equation is easily derived since $(\partial Y/\partial X)_t$ is known everywhere on the steam front. Starting with the well-known identity[12]

$$\left(\frac{\partial Y}{\partial X}\right)_t\left(\frac{\partial X}{\partial t}\right)_Y\left(\frac{\partial t}{\partial Y}\right)_X=-1 \tag{6.28}$$

and using (6.26), one may derive

$$p=-\left(\frac{\partial Y}{\partial X}\right)_t q \tag{6.29}$$

Equations (6.27) and (6.29) together yield a pair of solutions for the characteristic velocities. Thus, the proposed methods of the previous section generalize to two spatial dimensions.

6.3 The Extension of the Coordinate Transformation Procedure to Three Dimensions

To extend the procedure to three dimensions, we introduce, as the third coordinate direction Z, the axis of the horizontal well, so that we are working in a cylindrical coordinate system aligned with the axis of the steam chamber. This coordinate direction must now be discretized in a convenient manner. There are basically two possibilities: (i) to maintain a time-invariant, uniform grid spacing in the Z-direction; or (ii) to introduce another transformation to the Z-coordinate variable so that the axial tip of the steam chamber remains stationary in the transformed frame of reference.

The second approach has the advantage that we can impose a somewhat refined grid in the vicinity of the end of the steam chamber. This is desirable since the mechanism of heat conduction will largely control the steam chamber development; a refined grid at the tip will allow accurate calculation of conduction.

In this case, the transformation that would relate the X-Y-Z Cartesian coordinate system to the r-θ-Z^* cylindrical coordinate system would be

$$X = rR(Z^*, \theta, t)\cos\theta$$
$$Y = rR(Z^*, \theta, t)\sin\theta$$
$$Z = L(t)Z^*$$

It would also be possible to impose a spherical coordinate system and a time-dependent mapping that would map the ellipsoidal steam chamber onto a unit sphere. This transformation would take the form

$$X = r\bar{R}(\theta, \phi, t)\sin\theta\cos\phi$$
$$Y = r\bar{R}(\theta, \phi, t)\sin\theta\sin\phi$$
$$Z = r\bar{R}(\theta, \phi, t)\cos\theta$$

where θ and ϕ represent the latitudinal and longitudinal angles respectively. This would probably be the most straightforward way to extend the two-dimensional method, due to the similarity between this transformation and the analogous transformation in two dimensions. However, if the steam chamber does grow

successfully preferentially along the axis of the horizontal well as it is intended to do, the spherical mapping will constitute a substantial distortion, and it may not be possible to achieve an adequately fine mesh in the vicinity of the ends of the steam chamber.

It would appear that the transformation to cylindrical coordinates would be preferred over the spherical option. To obtain the governing transport equations in this coordinate system, we expand the derivatives of a dependent variable u with respect to the cylindrical coordinate variables in terms of the derivatives of the same variable u with respect to the Cartesian coordinate variables. This gives

$$\begin{bmatrix} \left(\frac{\partial u}{\partial r}\right)_{\theta,Z^*,t} \\ \left(\frac{\partial u}{\partial \theta}\right)_{r,Z^*,t} \\ \left(\frac{\partial u}{\partial Z^*}\right)_{r,\theta,t} \\ \left(\frac{\partial u}{\partial t}\right)_{r,\theta,Z^*} \end{bmatrix} = \begin{bmatrix} R\cos\theta & r(R_\theta\cos\theta - R\sin\theta) & rR_Z\cos\theta & rR_t\cos\theta \\ R\sin\theta & r(R_\theta\sin\theta + R\cos\theta) & rR_Z\sin\theta & rR_t\sin\theta \\ 0 & 0 & L & L_t Z^* \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} \left(\frac{\partial u}{\partial X}\right)_{Y,Z,t} \\ \left(\frac{\partial u}{\partial Y}\right)_{X,Z,t} \\ \left(\frac{\partial u}{\partial Z}\right)_{X,Y,t} \\ \left(\frac{\partial u}{\partial t}\right)_{X,Y,Z} \end{bmatrix}$$

We can solve this equation explicitly for the Cartesian derivatives as a function of the cylindrical derivatives. It is then straightforward to transform the three-dimensional governing equations.

The addition of the third dimension will not alter substantially the calculation of characteristic directions and velocities which are required for tracking the front.

References for Chapter 6

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7. CONCLUSIONS

A two-dimensional numerical simulator has been developed for describing the flow of steam, water, bitumen, and light hydrocarbons during a steam injection/gravity drainage process. The solution domain used is a vertical cross-section perpendicular to a horizontal well through which the bitumen is being drained. The simulator uses a moving coordinate transformation so that in the transformed coordinate system, the boundary of the steam chamber is stationary.

In test runs of the simulator, the predicted reservoir behaviour looked reasonable, except that the vapour saturation at the ceiling of the steam chamber dropped quickly to its residual value. The front-tracking formulation used in the simulator fails in this event. We attribute the rapid decrease in the vapour saturation to a deficiency of the finite-difference equations governing the fluid flow in the vicinity of the steam front – a deficiency which can be remedied by using front-tracking equations, derived according to the method of characteristics. We recommend that the appropriate equations be incorporated into the simulator.

The simulator includes the effect of gravity, and has been designed so that it can describe a bitumen with two volatile components, such as methane or a solvent from a solvent extraction process. The simulator also includes terms describing the vapour-phase diffusion of these volatile components within the steam. However, because of the fundamental difficulties described in the previous paragraph, we were unable to demonstrate the compositional capabilities of the simulator. We expect that the corrective action recommended in the preceding paragraph will enable the simulator to solve compositional problems.

We have concluded that the extension of the coordinate transformation method to three dimensions is surprisingly easy. The appropriate generalization of our polar-coordinate-based transformation is a cylindrical-coordinate-based transformation. The well-known techniques of linear algebra and multivariable calculus allow a straightforward generalization of the equations, although the number of equations does increase considerably. It is anticipated that the main problem in generalizing the coordinate transformation method to three dimensions will be in controlling the computation time requirements of the simulations.

Volume

2

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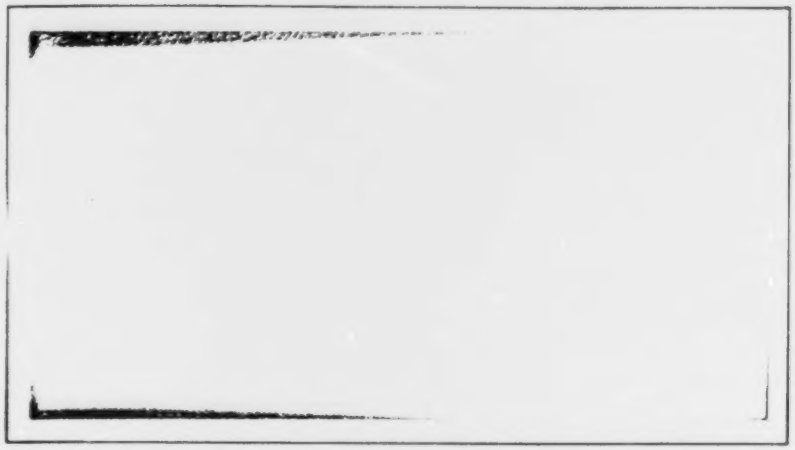

DEPARTMENT OF CHEMICAL ENGINEERING
AND APPLIED CHEMISTRY

NUMERICAL SIMULATION
OF
STEAM INJECTION IN BITUMEN
AND HEAVY OIL RESERVOIRS
PHASE II
VOLUME II

Computer Program Listing
and Sample Data
for the Simulator

Prepared for
The Department of Energy, Mines and Resources, Canada
under contract 0ST85-00427
20ST.23440-5-9235

by
Peter G. de Buda
and
Donald E. Cormack
Department of Chemical Engineering
and Applied Chemistry
University of Toronto

August, 1988

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     SAMPLE DATA FOR THE FRONT-FIXING STEAM CHAMBER SIMULATOR

STEAM DRIVE B.CONDITIONS, YES GRAVITY.  COLD LAKE DATA, HIGH PRESSURE
 .163000000   .102  .999  7    6    3
213   FFFFTTTT FF
CYLN F
10 T
 F          .0030000.000 0200000.000 0200000.000
 .2010   .1210   .1210    14 19 19
 5.0   3.2    1.50 0.67 0.67 1.0 1.0
 ....          0.1200D+01
 ....   0.93000+02   0.12000-01
 ....   0.93000+02   0.12000-01
LAST    0.82000+02   0.10000+01
 ....   0.80000+00
 ....   0.40000+00
FRNT    0.00000+00
 ....   0.40000+00
LAST    0.80000+00
 .50000-12    0.00 -9.81    .200   .090   .001



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 1.00000000+09   110.00   273.15 2.10580D+06 0.13080D+00
 1.07887700+09  1211.03   420.79 3.48226D+07
  60.0 1611.6600 1.3070  .0105
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 400.0     2.5000  .1180  .0174
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  .94900 0.00000 1.00000  0.0000
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F  0.0000000D+00 0.0           0.2500000D-00 0.1000000D+00
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                C          PROGRAMMER: PETER G. DE BUDA                                G0000080
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ISN        52           DOUBLE PRECISION MO,MWOIL,MSOL,MGP                             G0000760
ISN        53           DOUBLE PRECISION MOBGL,MOBWL,MOBOL,MOBTL                       G0000770
ISN        54           LOGICAL RCOND1                                                 G0000780
ISN        55           DOUBLE PRECISION MOBGR,MOBWR,MOBOR,MOBTR                       G0000790
ISN        56           LOGICAL RCOND2                                                 G0000800
ISN        57           CHARACTER*4 HORZ,VERT                                          G0000810
ISN        58           INTEGER FPJX,FPJY                                              G0000820
ISN        59           CHARACTER*4 FPHV                                               G0000830
ISN        60           LOGICAL LFRNT                                                  G0000840
ISN        61           LOGICAL LBNDOG,LBND8                                           G0000850
ISN        62           LOGICAL RCOND,INJECT                                           G0000860
ISN        63           DOUBLE PRECISION MOBG,MOBW,MOBO,MOBT                           G0000870
ISN        64           LOGICAL OUTLIE                                                 G0000880
ISN        65           LOGICAL BLSPEC                                                 G0000890
ISN        66           INTEGER EDSIGN                                                 G0000900
ISN        67           CHARACTER*4 JORIEN,EDGOR                                       G0000910
ISN        68           LOGICAL FREDGE,LBNDED,LNULED                                   G0000920
ISN        69           LOGICAL TEST,TEST1,TEST2,TEST3,TEST4,TEST5,TEST6,TEST7,TEST8   G0000930
ISN        70           CHARACTER*4 CYLN,SPHR,CSYSTM                                   G0000940
ISN        71           LOGICAL L2SYMM,LCIRCL                                          G0000950
ISN        72           CHARACTER*6 TRANSP,MATCHC,BOTH,NEITHR,EQTYPE                   G0000960
ISN        73           CHARACTER*4 CENT,FRN1,FRN0,BOUN,AXIS,INTR,EDTYPE               G0000970
ISN        74           LOGICAL LROCX                                                  G0000980
ISN        75           LOGICAL LNEMNR,LNELL                                           G0000990
                C                                                                      G0001000
ISN        76           COMMON/NRITE1/OOISTX(55),OP(55),OT(55),OSWP(55),OSOP(55),OSGP(55),G0001010
                       1             OXMOLE(3,55),OYMOLE(4,55),                      G0001020
                       2             OR(55),OO(55),OV(55),TIME,STORDT,OAINJV,OPRODV, G0001030
                       3             OEQUIL(55),IJKLMN,IMAXN,IFIRST,IEND             G0001040
ISN        77           COMMON/NRITE2/AMTINP(10),CUMINJ(11),CUMPRD(10),BALERR(10)      G0001050
ISN        78           COMMON/NRITE3/FLOTOT,FLOWAT,FLOOIL,FLOGAS,CUMEWL,CUMWAT,CUMSVL,G0001060
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                      1              CUMVOL,CUMINT,CUMENG,CUMSTM,CUMSVG,CUMVOG,CUMPVI,      G0001070
                      2              PRDOIL,PRDMAT,PRDGAS                                   G0001080
ISN      79          COMMON/ISTAGE/ITIME,ITERAT                                            G0001090
ISN      80          COMMON/PRMBLK/SMC,SOIRR,SGIRR,SGPDUM,SWPDUM,KRGDUM,KROG,KROW,         G0001100
                                  KRWDUM,KRODUM,KRGSGD,KROGSG,KROWSM,KRWSMD,KROSGD,      G0001110
                      2           KROSMD,PCWDUM,PCVDUM,                                  G0001120
                      3           LCTN,IERR,IWRONG                                       G0001130
ISN      81          COMMON/PVAPOR/PMAT(55),POIL(55),PSOL(55),DPMAT(55),DPOIL(55),      G0001140
                      1           DPSOL(55),DPDT(55),YMOLE(4,55),YO(55),YY(55),YS(55)    G0001150
ISN      82          COMMON/EQLBRM/PEQUIL,                                                 G0001160
                      1           EQMA01,EQMA10,VDUCPT,VOUCSC,EQUIL(55)                  G0001170
ISN      83          COMMON/VPCONS/AM,BM,AO,BO,CO,ASOL,BSOL,CSOL,TO(55)                    G0001180
ISN      84          COMMON/GAMMA13/GAMMA1,GAMMA2,GAMMA3                                   G0001190
ISN      85          COMMON/INJSPC/PGRDNT,TOTINJ,VAPINJ(28),HCBINJ(28),MATINJ(28),      G0001200
                      1           VLCTY,HC1INJ(28),HC2INJ(28),HC3INJ(28),                G0001210
                      2           VO1INJ(28),VO2INJ(28),VMAINJ(28)                       G0001220
ISN      86          COMMON/GICS13/GIC18,GIC34,GIC38,GIC43                                 G0001230
ISN      87          COMMON/GRIPRO/DT,DXFRNT,DISXM,DX(57),DISTX(58),MFRONT,NBLOKS,      G0001240
                      1           NG,NJAY,COORTR,TRACKF,OVTAKE,DATAFR,RESTRT             G0001250
ISN      88          COMMON/VPLCON/TOHOLD                                                  G0001260
ISN      89          COMMON/TOL123/TOL,TOL1,TOL2                                           G0001270
ISN      90          COMMON/LOGMIS/OUT,REPEAT,JCTEST,JTINIT,ITERPR,BYWEIT                  G0001280
ISN      91          COMMON/STATEV/SWP(55),SGP(55),SOP(55),T(55),P(55),                 G0001290
                      1           XMOLE(3,55),XO(55),XSOL(55),XW(55)                     G0001300
ISN      92          COMMON/FLUPRO/DWP(55),DOP(55),DGP(55),UWP(55),UOP(55),UGP(55),     G0001310
                      1           CWP(55),COP(55),CGP(55),KO(55),KSOL(55),LAMBDA(55),    G0001320
                      2           DENSOL(55),DENSOH(55),DENSOS(55),                      G0001330
                      3           DFSPCW(55),DFSPCO(55),DFSPCV(55),GASCON                G0001340
ISN      93          COMMON/HVAPOR/HVAPS,HVAPO,HVAPSV                                      G0001350
ISN      94          COMMON/RESPRO/KA,KC(55),PHI(55),DBCB(55),PCAPW(55),PCAPV(55)          G0001360
ISN      95          COMMON/PRM123/KRGP(55),KROP(55),KRWP(55),AKROG(55),AKROW(55)          G0001370
                C        448 = 112*(3+1)                                                  G0001380
                C     IMSUPT(112,09) WAS REPLACED BY IMSUPT IN THE COMMON BLOCK.          G0001390
                C          1008 = 168*(5+1)                                               G0001400
                C     IMSUSC(168,13) WAS REPLACED BY IMSUSC IN THE COMMON BLOCK.          G0001410
                C                                                                        G0001420
ISN      96          COMMON/CPUTIM/CPUOLD,DELCPU(18)                                       G0001430
ISN      97          COMMON/CPLCPV/CPLWA(55),CPVWA(55),CPLOL(55),CPVOL(55),             G0001440
                      1           CPLOS(55),CPVOS(55),CPLOH(55)                          G0001450
ISN      98          COMMON/SWIT  /SWIT1,SWIT2,SWIT3,SWIT4,SWIT5,SWIT6,SWIT7,SWIT8         G0001460
ISN      99          COMMON/BETAS /BETATM,BETRAT,HBETIN,BETAPT,BETASC,BESRAT,HBESIN        G0001470
ISN     100          COMMON/MWEITS/MO,MWOIL,MSOL,MGP,RTMMAT,RTMOIL,RTMINT,RTMSOL           G0001480
ISN     101          COMMON/BALANC/CUMNJI(10),CUPRDI(10),AMINPI(10)                        G0001490
ISN     102          COMMON/PRDVAR/PRDENL,          PRDSVL,PRDVOL,PRDINT,               G0001500
                      1           PRDENG,PRDSTM,PRDSVG,PRDVOG                            G0001510
ISN     103          COMMON/ADJSAT/FRDSW(55)                                               G0001520
ISN     104          COMMON/LMHOLD/XLOG10                                                  G0001530
ISN     105          COMMON/FLOWS /PORVOL,FLINJ(11),OFLINJ(11),FLPRD(10),OFLPRD(10)        G0001540
ISN     106          COMMON/INJCND/RATEL,PSPECL,MOBGL,MOBWL,MOBOL,MOBTL,                G0001550
                      1           AINJV,TSPECL,                                          G0001560
                      2           RCONDL                                                 G0001570
ISN     107          COMMON/PRDCND/RATER,PSPECR,MOBGR,MOBWR,MOBOR,MOBTR,                G0001580
                      1           PRODV,TSPECR,                                          G0001590
                      2           RCONDR                                                 G0001600
ISN     108          COMMON/PROP  /ODGP(55),ODWP(55),ODOP(55),OPHI(55)                     G0001610
ISN     109          COMMON/TAUS  /X1L,X1R,TAUGP1,TAUGP2,TAUWP1,TAUWP2,TAUOP1,TAUOP2       G0001620
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ISN     110          COMMON/YCHALF/YOIPH,YOIMH,YVIPH,YVIMH,YSIPH,YSIMH,                 G0001630
                      1           KOIPH,KOIMH,KSIPH,KSIMH                                G0001640
ISN     111          COMMON/CNDENS/R(55),D(55),V(55)                                       G0001650
ISN     112          COMMON/CRATIO/CRAT1,CRAT2,DCDTIP,DCDTI,DCDTIN,DCDPI                   G0001660
                C        LINES 45.1/45.4 ARE RESERVED FOR CHECKING THE JACOBIAN.        G0001670
ISN     113          COMMON/OTERMS/QENIWP(55),QWATIP(55),QOILIP(55),QGASIP(55),         G0001680
                      1           QENFLX(55),QDISXM,QACUMB(9,4)                          G0001690
ISN     114          COMMON/ENHLPV/ENHLWA(55),ENHVWA(55),ENHLOS(55),ENHVOS(55),         G0001700
                      1           ENHLOL(55),ENHVOL(55),ENHLOH(55),                      G0001710
                      2           ENHWP(55),  ENHOP(55),  ENHVP(55)                      G0001720
                      3           ENHWPH,ENHWPH,ENHOPH,ENHOPH,ENHVPH,ENHVPH              G0001730
                C        44.2/44.3 44.3/44.4 ARE NOT USED IN THE OLD SCEQNS.           G0001740
ISN     115          COMMON/TABLE1/TACTEN(12),TALMUO(12),TALMUW(12),TAMMUG(12),         G0001750
                      1           IENTT(55),NENTTT                                       G0001760
ISN     116          COMMON/TABLE2/TABXW(8),TABUOR(8),IENTXW(55),NENTXW                    G0001770
ISN     117          COMMON/TABLE3/TABSW(16),TABKRW(16),TABKOW(16),TABPCW(16),          G0001780
                      1           IENTSW(55),NENTSW                                      G0001790
ISN     118          COMMON/TABLE4/TABSL(18),TABKRG(18),TABKOG(18),TABPCV(18),          G0001800
                      1           IENTSL(55),NENTSL                                      G0001810
ISN     119          COMMON/TABLE5/STMTAB(20,6),IENTT2(55),NENTT2                          G0001820
ISN     120          COMMON/ERRORT/ITABL                                                   G0001830
ISN     121          COMMON/CTEMP1/MMCS                                                    G0001840
                C     COMMON/FRAC13/FRACG,FRACO,FRACW WAS DELETED.                       G0001850
ISN     122          COMMON/BASICS/ZERO,HALF,ONE,TWO                                       G0001860
ISN     123          COMMON/IBASCS/NULL                                                    G0001870
ISN     124          COMMON/MAXES /NGRPMX                                                  G0001880
ISN     125          COMMON/DIMENS/NDIMXS,NX,NY,NOS,NRS,NRFM,NRFP                          G0001890
ISN     126          COMMON/DIRXNC/HORZ,VERT                                               G0001900
ISN     127          COMMON/FRONT1/NFPTOT,FPJX(16),FPJY(16)                                G0001910
ISN     128          COMMON/FRONT2/FPHV(16)                                                G0001920
ISN     129          COMMON/FRONT3/FPDIST(16),FPDISX(16),FPDISY(16),FPDSNM(16)             G0001930
ISN     130          COMMON/TABLS1/NBLKS,NGRPS,JGRPOG(50),JAGPOF(9,16),                 G0001940
                      1           JBLK(55),JFPT(55)                                      G0001950
ISN     131          COMMON/TABL1A/LFRNT(55)                                               G0001960
ISN     132          COMMON/BTBLS1/NBNDBS,JBNDOG(55),JBNDB(50),JBLKOB(28),JINTOB(28)       G0001970
ISN     133          COMMON/BTBL1A/LBNDOG(55),LBNDB(50)                                    G0001980
ISN     134          COMMON/SPEC3 /TSPEC(28),PSPEC(28),FSPEC(28)                           G0001990
ISN     135          COMMON/SPEC4 /RCOND(28),INJECT(28)                                    G0002000
ISN     136          COMMON/BVOLFL/BVFLOW(28),FLFR(50)                                     G0002010
ISN     137          COMMON/BMOBS /MOBG(28),MOBW(28),MOBO(28),MOBT(28)                     G0002020
ISN     138          COMMON/GRAVTY/GX,GY,DENMSW(55),DENMSO(55),DENMSV(55),GRAVP(55)        G0002030
ISN     139          COMMON/SCLMIS/FDAMP,ABTOLP                                            G0002040
ISN     140          COMMON/YALC01/NUS,NCONXS,JBDIAG,J1CONX(55),NNEIBS(55),             G0002050
                      1           JGRPOC(715),JNEIBR(715)                                G0002060
ISN     141          COMMON/YALC02/NBANMX,JCONX(73,55)                                     G0002070
ISN     142          COMMON/YALC0L/OUTLIE(715)                                             G0002080
ISN     143          COMMON/BLXY  /BLX(50),BLY(50)                                         G0002090
ISN     144          COMMON/CBCORX/BLCORX(8,50)                                            G0002100
ISN     145          COMMON/CBCORY/BLCORY(8,50)                                            G0002110
ISN     146          COMMON/CBSPEC/BLSPEC(8,50)                                            G0002120
ISN     147          COMMON/CBAREA/BLAREA(50),OBAREA(50)                                   G0002130
ISN     148          COMMON/GPXY  /GPX(55),GPY(55)                                         G0002140
ISN     149          COMMON/OLDFT1/OCONCL(5,55),OCONCV(5,55)                               G0002150
ISN     150          COMMON/OLDFT2/OSAREA(5,16)                                            G0002160
ISN     151          COMMON/EDSMAL/NDIRS,NEDGES,EDSIGN(8)                                  G0002170
ISN     152          COMMON/EDCHAR/JORIEN(8),EDGOR(150)                                    G0002180
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ISN      153          COMMON/EDLOGC/FREDGE(150),LBNDED(150),LNULED(150)                              G0002190
ISN      154          COMMON/EDTOE1/JBLKOE(4,150)                                                   G0002200
ISN      155          COMMON/EDTOE2/JGRPOE(6,150),JDIROE(2,150)                                     G0002210
ISN      156          COMMON/EDTOG /JEDGOG(8,55)                                                    G0002220
ISN      157          COMMON/EDTOF /JEDGOF(2,16),JPEDMO(16),JPEDVE(16)                              G0002230
ISN      158          COMMON/FRTOF /JPFPHO(16),JPFPVE(16),JPFPPO(16),JPFPNE(16)                     G0002240
ISN      159          COMMON/YALED1/J1EFEC(55),NIEDGS(55),                                          G0002250
                     1             JIGRUP(825),JIEDGE(825)                                         G0002260
ISN      160          COMMON/YALED2/RESRVD                                                          G0002270
ISN      161          COMMON/EDLOCT/EDSTAX(150),EDSTAY(150),EDFINX(150),EDFINY(150)                 G0002280
ISN      162          COMMON/SCALES/SCALEP,SCALEH,SCALEV,SCALVF                                     G0002290
ISN      163          COMMON/EXAMIN/TEST,TEST1,TEST2,TEST3,TEST4,TEST5,TEST6,TEST7,TEST8            G0002300
ISN      164          COMMON/ADJACN/IFORML,JUPGRP(16),JADJAC(4,55)                                  G0002310
ISN      165          COMMON/OFFSET/JOFSMN,JOFSMX                                                   G0002320
ISN      166          COMMON/IBCONS/IHEQN,IHBAL,IVEQN,IVBAL                                         G0002330
ISN      167          COMMON/PIES  /HALFPI,PI,TWOPI,PI0180                                          G0002340
ISN      168          COMMON/CORSYS/CYLN,SPHR,CSYSTM                                                G0002350
ISN      169          COMMON/LOGSYM/L2SYMM,LCIRCL                                                   G0002360
ISN      170          COMMON/EQNTYP/TRANSP,MATCHC,BOTH,NEITHR,EQTYPE(10,3)                          G0002370
ISN      171          COMMON/EDGTYP/CENT,FRNI,FRNO,BOUN,AXIS,INTR,EDTYPE(150)                       G0002380
ISN      172          COMMON/EQNTCD/IEQCOD(10,55)                                                   G0002390
ISN      173          COMMON/IJTBIJ/IOFGRP(55),JOFGRP(55),JGRPIJ(36,24)                             G0002400
ISN      174          COMMON/TABLS2/NRLGS,JGRPOF(16),JRLG(55),JGRPDR(54)                            G0002410
                     1             JGPTNR(55),JTYFRM(55),JTYRFL(55),JRFLIM(55)                     G0002420
ISN      175          COMMON/LROCXC/LROCX(150)                                                      G0002430
ISN      176          COMMON/GLINEC/GLINEO(36),GLINER(24)                                           G0002440
ISN      177          COMMON/TGRID /SINTHT(36),COSTHT(36),SINTHA(36),COSTHA(36),                    G0002450
                     1             SINIPA(36),COSIPA(36),SINIMA(36),COSIMA(36),                    G0002460
ISN      178          COMMON/DGRID /DTHTAP(36),DTHTAM(36),DOPHIH(36),DTHETA(36),                    G0002470
                     1             DFOMTP(36),DFOMTM(36),                                          G0002480
                     2             DRPHIH(24),DRADP1(24),DRADM1(24)                                G0002490
ISN      179          COMMON/FRNTCF/DCENDS,CENDIS,FRNDIS(36),DFRDTH(36),FRFRTH(36),                 G0002500
                     1             YFDOTN(36),XIRING(36),YIRING(36)                                G0002510
ISN      180          COMMON/OFRNCF/OFRNDS(36)                                                      G0002520
ISN      181          COMMON/WELLXY/XWELL(11),YWELL(11)                                             G0002530
ISN      182          COMMON/WELLJ1/NWELLS,IENTMO(11),IENTMR(11),JGNEAR(11),                        G0002540
                     1             JWELOG(55)                                                      G0002550
ISN      183          COMMON/WELLJ2/JGPSC(8,11)                                                     G0002560
ISN      184          COMMON/WELLLG/LWENNR(11),LWELL(55)                                            G0002570
                C                                                                                  G0002580
                C                                                                                  G0002590
                C    1.  INITIALIZATION AND DATA INPUT                                             G0002600
                C                                                                                  G0002610
ISN      185          IVERSN=8                                                                      G0002620
ISN      186          NBALAR=10                                                                     G0002630
ISN      187          REMIND 3                                                                      G0002640
ISN      188          ZERO=0.000                                                                    G0002650
ISN      189          HALF=0.5D0                                                                    G0002660
ISN      190          ONE =1.000                                                                    G0002670
ISN      191          TWO =2.000                                                                    G0002680
ISN      192          NULL=-97                                                                      G0002690
ISN      193          HORZ='HORZ'                                                                   G0002700
ISN      194          VERT='VERT'                                                                   G0002710
ISN      195          GASCON=8.31445D3                                                              G0002720
ISN      196          XLOG10=DLOG(10.D0)                                                            G0002730
ISN      197          NMSIZE= 56                                                                    G0002740
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ISN      198          NGRPMX= 55                                                                    G0002750
ISN      199          NRLGMX= 54                                                                    G0002760
ISN      200          NBLKMX= 50                                                                    G0002770
ISN      201          NBNDMX= 28                                                                    G0002780
ISN      202          NMELMX= 11                                                                    G0002790
ISN      203          NDIRMX=  8                                                                    G0002800
ISN      204          NFPTMX= 16                                                                    G0002810
ISN      205          NCONMX=715                                                                    G0002820
ISN      206          NXMAX = 57                                                                    G0002830
ISN      207          NXP1MX=NXMAX+1                                                                G0002840
ISN      208          NYMAX = 12                                                                    G0002850
ISN      209          NOMAX=36                                                                      G0002860
ISN      210          NRMAX=24                                                                      G0002870
                C     NBANMX= 59  IS PREMATURE.                                                     G0002880
ISN      211          NBANMX=73                                                                     G0002890
ISN      212          NEDGMX=150                                                                    G0002900
ISN      213          NEFCMX=825                                                                    G0002910
ISN      214          MATRMX= 60                                                                    G0002920
ISN      215          NMCS  =  3                                                                    G0002930
ISN      216          NCOMPS=NMCS+2                                                                 G0002940
ISN      217          NVARS =NMCS+2                                                                 G0002950
                C     NBALNS IS CALCULATED WHEN COORTR IS KNOWN.                                    G0002960
ISN      218          IHEQN=5                                                                       G0002970
ISN      219          IHBAL=2*NCOMPS+1                                                              G0002980
ISN      220          IVEQN=NMCS+1                                                                  G0002990
ISN      221          IVBAL=2*NCOMPS+2                                                              G0003000
ISN      222          NUMAX =NVARS*NGRPMX                                                           G0003010
ISN      223          LFULL=.TRUE.                                                                  G0003020
ISN      224          LDA   =275                                                                    G0003030
                C        LDA AND THE DECLARED SPACE IN ABD MUST BE EXACTLY EQUAL.                  G0003040
                C        LDA SHOULD BE AT LEAST (NVARS*(NBANMX+1)+3) / 2                           G0003050
                C        (IF THE BANDED FORM FOR THE JACOBIAN IS USED)                             G0003060
ISN      225          FDAMP =ONE                                                                    G0003070
ISN      226          ABTOLP=1.00-5                                                                 G0003080
ISN      227          SCALEP=1.00+6                                                                 G0003090
ISN      228          SCALEH=1.00-6                                                                 G0003100
                C     SCALEV=1.00+6 HAS CHANGED, AND MOVED TO 502.9                                 G0003110
ISN      229          SCALVF=ONE                                                                    G0003120
ISN      230          PI=3.14159265358979300                                                        G0003130
ISN      231          HALFPI=PI*HALF                                                                G0003140
ISN      232          TWOPI =PI*TWO                                                                 G0003150
ISN      233          PI0180=PI/1.8002                                                              G0003160
                C                                                                                  G0003170
ISN      234          EDSIGN(1)=-1                                                                  G0003180
ISN      235          EDSIGN(2)=-1                                                                  G0003190
ISN      236          EDSIGN(3)=+1                                                                  G0003200
ISN      237          EDSIGN(4)=+1                                                                  G0003210
ISN      238          EDSIGN(5)=+1                                                                  G0003220
ISN      239          EDSIGN(6)=+1                                                                  G0003230
ISN      240          EDSIGN(7)=-1                                                                  G0003240
ISN      241          EDSIGN(8)=-1                                                                  G0003250
                C                                                                                  G0003260
ISN      242          JORIEN(1)=HORZ                                                                G0003270
ISN      243          JORIEN(2)=HORZ                                                                G0003280
ISN      244          JORIEN(3)=VERT                                                                G0003290
ISN      245          JORIEN(4)=VERT                                                                G0003300
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                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
ISN      246          JORIEN(5)=HORZ                                                  G0003310
ISN      247          JORIEN(6)=HORZ                                                  G0003320
ISN      248          JORIEN(7)=VERT                                                  G0003330
ISN      249          JORIEN(8)=VERT                                                  G0003340
                C                                                                    G0003350
ISN      250          TEST=.TRUE.                                                     G0003360
ISN      251          TOHOLD=.FALSE.                                                  G0003370
ISN      252          ERULCO=3                                                        G0003380
ISN      253          MAXERR=2                                                        G0003390
ISN      254          WRITE(6,8000)                                                   G0003400
ISN      255          WRITE(9,8000)                                                   G0003410
ISN      256    8000  FORMAT('1',20X,'THESE ARE THE NUMBERS WHICH THE SIMULATOR USES'/ G0003420
                     1' ')                                                           G0003430
                CCCCC                                                                G0003440
                C         ISIMS: THE NUMBER OF SIMULATIONS DESIRED.                  G0003450
                C                THIS NUMBER HAS ALWAYS BEEN SET TO 1.               G0003460
                C                                                                    G0003470
ISN      257          READ (5,8001)ISIMS                                              G0003480
ISN      258          WRITE(6,8001)ISIMS                                              G0003490
ISN      259          WRITE(9,8001)ISIMS                                              G0003500
ISN      260    8001  FORMAT(1X,I2)                                                  G0003510
ISN      261          DO 119 IIIJK=1,ISIMS                                            G0003520
                C                                                                    G0003530
                C         TITLE: THE ONE-LINE TITLE OF THE SIMULATION.               G0003540
                C                THE MAXIMUM LENGTH ALLOWED IS 72 CHARACTERS.        G0003550
                C                                                                    G0003560
ISN      262          READ (5,3909)(TITLE(I),I=1,18)                                  G0003570
ISN      263          WRITE(6,3909)(TITLE(I),I=1,18)                                  G0003580
ISN      264          WRITE(9,3909)(TITLE(I),I=1,18)                                  G0003590
ISN      265    3909  FORMAT(1X,17A4,A3)                                             G0003600
                CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCG0003610
                C         TIMMAX: THE MAXIMUM LENGTH OF THE SIMULATION               G0003620
                C                 (IN RESERVOIR SECONDS)                             G0003630
                C                                                                    G0003640
                C         MAXSTP: THE MAXIMUM NUMBER OF TIME STEPS ALLOWED DURING    G0003650
                C                 THE SIMULATION.                                    G0003660
                C                 NORMALLY, TIMMAX AND MAXSTP COMPETE TO END THE     G0003670
                C                 SIMULATION.                                        G0003680
                C                                                                    G0003690
                C          ISTOP: NOT USED IN THE CURRENT VERSION OF THIS SIMULATOR. G0003700
                C                 HOWEVER, ISTOP SHOULD BE SET TO LARGER THAN MAXSTP. G0003710
                C                 OTHERWISE, ISTOP MIGHT INTERFERE IF THE SIMULATOR  G0003720
                C                 ENCOUNTERS CONVERGENCE PROBLEMS OR OTHER DIFFICULTIES. G0003730
                C                                                                    G0003740
                C         ILITER: NOT USED IN THE CURRENT VERSION OF THIS SIMULATOR. G0003750
                C                 (BUT IT MIGHT AFFECT THE SIMULATOR IF ISTOP IS     G0003760
                C                 NOT LARGER THAN MAXSTP.)                           G0003770
                C                                                                    G0003780
                C         IFIRST: CONTROLS OUTPUT: OUTPUT IS PRODUCED FOR EACH OF THE G0003790
                C                 FIRST IFIRST TIME STEPS.                           G0003800
                C                                                                    G0003810
                C         IINTVL: CONTROLS OUTPUT: (AFTER THE FIRST IFIRST TIME STEPS), G0003820
                C                 OUTPUT IS PRODUCED FOR EVERY IINTVL-TH TIME STEP.  G0003830
                C                                                                    G0003840
ISN      266          READ (5,8012)TIMMAX,MAXSTP,ISTOP,ILITER,IFIRST,IINTVL           G0003850
ISN      267          WRITE(6,8012)TIMMAX,MAXSTP,ISTOP,ILITER,IFIRST,IINTVL           G0003860
```



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                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
ISN      268          WRITE(9,8012)TIMMAX,MAXSTP,ISTOP,ILITER,IFIRST,IINTVL           G0003870
ISN      269    8012  FORMAT(1X,F11.0,1X,I4,1X,I4,1X,I2,1X,I3,1X,I3)                 G0003880
                CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCG0003890
                C         NDIMNS: THE NUMBER OF DIMENSIONS.                          G0003900
                C                                                                    G0003910
                C         COORTR: T - USE THE CURRENT COORDINATE TRANSFORMATION VERSION G0003920
                C                     OF THIS SIMULATOR.                             G0003930
                C                 F - USE SOME PREVIOUS VERSION OF THIS SIMULATOR.   G0003940
                C                                                                    G0003950
                C          SWIT2: F - PRINT OUT DETAILED INFORMATION ABOUT EACH      G0003960
                C                     ITERATION.                                     G0003970
                C                 T - SUPPRESS PRINTING OUT THESE DETAILS.           G0003980
                C                                                                    G0003990
                C          SWIT6: F - IF THE DETAILS CONTROLLED BY SWIT2 ARE SUPPRESSED, G0004000
                C                     AT LEAST PRINT OUT THE PRESSURES.              G0004010
                C                 T - SUPPRESS EVEN THE PRESSURES.                   G0004020
                C                     IF SWIT2 IS FALSE, THEN THE VALUE OF SWIT6     G0004030
                C                     DOES NOT MATTER.                               G0004040
                C                                                                    G0004050
                C          SWIT7: F - PRINT OUT THE RAW SOLUTION AND THE RESIDUAL AS G0004060
                C                     CALCULATED BY THE LINEAR EQUATION SOLVER.      G0004070
                C                 T - SUPPRESS PRINTING OUT THESE DETAILS.           G0004080
                C                                                                    G0004090
                C         THE OTHER VARIABLES IN THIS READ STATEMENT ARE NOT USED     G0004100
                C         IN THE CURRENT VERSION OF THIS SIMULATOR.                  G0004110
                C                                                                    G0004120
ISN      270          READ (5,8002)NDIMNS,COORTR,IFORML,SWIT1,SWIT2,SWIT3,SWIT4,SWIT5, G0004130
                     1     SWIT6,SWIT7,SWIT8,JCKPPT,JCKPSC                           G0004140
ISN      271          WRITE(6,8002)NDIMNS,COORTR,IFORML,SWIT1,SWIT2,SWIT3,SWIT4,SWIT5, G0004150
                     1     SWIT6,SWIT7,SWIT8,JCKPPT,JCKPSC                           G0004160
ISN      272          WRITE(9,8002)NDIMNS,COORTR,IFORML,SWIT1,SWIT2,SWIT3,SWIT4,SWIT5, G0004170
                     1     SWIT6,SWIT7,SWIT8,JCKPPT,JCKPSC                           G0004180
ISN      273    8002  FORMAT(1X,I1,1X,I1,1X,I1,3X,8L1,1X,2L1)                        G0004190
ISN      274          IF (.NOT.COORTR) NBALNS=2*NCOMPS                                G0004200
ISN      276          IF (.NOT.COORTR) NBALNS=2*NCOMPS+2                              G0004210
ISN      278          IF (.NOT.COORTR) NDIRS=4                                        G0004220
ISN      280          IF (.NOT.COORTR) NDIRS=8                                        G0004230
ISN      282          IF (NBALNS.NE.NBALAR) WRITE(6,80021)NBALNS,NBALAR               G0004240
ISN      284    80021 FORMAT(' ***** NBALNS (=',I2,') AND NBALAR (=',I2,')',         G0004250
                     1' ARE NOT EQUAL')                                              G0004260
ISN      285          IF (COORTR) THEN                                                G0004270
                CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCG0004280
                C         CSYSTH: CYLN = CYLINDRICAL COORDINATES                     G0004290
                C                 SPHR = SPHERICAL   COORDINATES                     G0004300
                C                                                                    G0004310
                C         L2SYMH: TRUE = USE (-PI/2,+PI/2) TO EXPLOIT THE            G0004320
                C                        2-FOLD SYMMETRY.                            G0004330
                C                 FALSE = USE (-PI  ,+PI  )                          G0004340
                C                                                                    G0004350
ISN      286          READ (5,80023)CSYSTH,L2SYMH                                     G0004360
ISN      287          WRITE(6,80023)CSYSTH,L2SYMH                                     G0004370
ISN      288          WRITE(9,80023)CSYSTH,L2SYMH                                     G0004380
ISN      289    80023 FORMAT(1X,A4,1X,L1)                                            G0004390
ISN      290          LCIRCL=.NOT.L2SYMH                                              G0004400
ISN      291          END IF                                                          G0004410
                C                                                                    G0004420
```

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                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
                C
                C        THE VARIABLES IN THIS READ STATEMENT ARE NOT USED                  G0004430
                C        IN THE CURRENT VERSION OF THIS SIMULATOR.                          G0004440
                C                                                                           G0004450
ISN      292            READ (5,80025)NBLOKS,TRACKF,DATAFR,DOXMAX,DOXMIN,MFRONT,DXFRNT     G0004460
ISN      293            WRITE(6,80025)NBLOKS,TRACKF,DATAFR,DOXMAX,DOXMIN,MFRONT,DXFRNT     G0004470
ISN      294            WRITE(9,80025)NBLOKS,TRACKF,DATAFR,DOXMAX,DOXMIN,MFRONT,DXFRNT     G0004480
ISN      295     80025  FORMAT(1X,I2,1X,2L1,2F6.3,1X,I2,1X,D12.5)                          G0004490
ISN      296            IF (DATAFR) GO TO 270                                              G0004500
                C        DEFINE MFRONT EVEN IF THERE IS NO FRONT-TRACKING.                  G0004510
ISN      297            MFRONT=2                                                           G0004520
ISN      298            DXFRNT=1.0D-3                                                      G0004530
ISN      299        270 CONTINUE                                                           G0004540
                C                                                                           G0004550
ISN      300            CALL TRAPS(0,0,100000,0,0)                                         G0004560
                C          THE VS/FORTRAN VERSION REQUIRES THAT TRAPS BE CALLED             G0004570
                C          ONLY AFTER TRACKF IS DEFINED.                                    G0004580
                C                                                                           G0004590
                C          RESTRT: T = THE INPUT DATA HAS BEEN GENERATED FROM A PREVIOUS    G0004600
                C                      SIMULATION RUN.                                      G0004610
                C                  F = THE INPUT DATA REPRESENTS CONDITIONS AT TIME=0 .      G0004620
                C                                                                           G0004630
                C          IJKLMN: THIS VARIABLE HELPS CONTROL THE FREQUENCY AT WHICH       G0004640
                C                  OUTPUT FROM TIME STEPS IS PRODUCED, AND HELPS CONTROL    G0004650
                C                  THE TIME STEP EXTRAPOLATION.                             G0004660
                C                                                                           G0004670
                C          DTINIT: THE INITIAL SIZE OF THE TIME STEP (DT) (IN SECONDS).     G0004680
                C                                                                           G0004690
                C          DTCUTO: NOT USED IN THE CURRENT VERSION OF THIS SIMULATOR.       G0004700
                C                                                                           G0004710
                C          DTMAX:  THE MAXIMUM ALLOWED SIZE OF THE TIME STEP (IN SECONDS).  G0004720
                C                                                                           G0004730
                C           TIME:  THE INITIAL VALUE OF TIME DURING THE SIMULATION          G0004740
                C                  (IN SECONDS).                                            G0004750
                C                                                                           G0004760
ISN      301            READ (5,8003)RESTRT,IJKLMN,DTINIT,DTCUTO,DTMAX,TIME                G0004770
ISN      302            WRITE(6,8003)RESTRT,IJKLMN,DTINIT,DTCUTO,DTMAX,TIME                G0004780
ISN      303            WRITE(9,8003)RESTRT,IJKLMN,DTINIT,DTCUTO,DTMAX,TIME                G0004790
ISN      304            NRSTRT=.TRUE.                                                      G0004800
ISN      305     8003   FORMAT(2X,L1,I2,6X,3F12.3,F13.1)                                   G0004810
                C                                                                           G0004820
                C          IENDNL: THE MAXIMUM ALLOWED NUMBER OF ITERATIONS BEFORE          G0004830
                C                  RECALCULATING WITH A SMALLER TIME STEP.                  G0004840
                C                                                                           G0004850
                C          THE OTHER VARIABLES IN THIS READ STATEMENT ARE NOT USED           G0004860
                C          IN THE CURRENT VERSION OF THIS SIMULATOR.                        G0004870
                C                                                                           G0004880
ISN      306            READ (5,8004)TOL,TOL1,TOL2,ITMAX,IENDNL,IENDEQ                     G0004890
ISN      307            WRITE(6,8004)TOL,TOL1,TOL2,ITMAX,IENDNL,IENDEQ                     G0004900
ISN      308            WRITE(9,8004)TOL,TOL1,TOL2,ITMAX,IENDNL,IENDEQ                     G0004910
ISN      309     8004   FORMAT(1X,3F7.4,2X,3I3)                                            G0004920
                C   CONVERT TOL2 FROM PERCENTAGE TO ABSOLUTE:                             G0004930
ISN      310            TOL2=TOL2/100.D0                                                   G0004940
ISN      311            IF (SMIT3) GO TO 249                                               G0004950
ISN      312            CPUOLD=ZERO                                                        G0004960
ISN      313            DO 240 ICHECK=1,18                                                 G0004970
ISN      314            DELCPU(ICHECK)=ZERO                                                G0004980
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                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
ISN      315        240 CONTINUE                                                           G0004990
ISN      316            ITMDSK=1                                                           G0005000
ISN      317            IF (NBLOKS.GT.9) ITMDSK=2                                          G0005010
ISN      319            REWIND ITMDSK                                                      G0005020
ISN      320        249 CONTINUE                                                           G0005030
                C                                                                           G0005040
                C          BIGMAX: UPPER LIMIT ON THE MAXIMUM SATURATION CHANGE           G0005050
                C                  DURING THE TIME STEP (PERCENTAGE).                       G0005060
                C                                                                           G0005070
                C          BIGMIN: LOWER LIMIT ON THE MAXIMUM SATURATION CHANGE           G0005080
                C                  DURING THE TIME STEP (PERCENTAGE).                       G0005090
                C                                                                           G0005100
                C          BIGGER: FACTOR BY WHICH THE TIME STEP IS INCREASED IF          G0005110
                C                  THE MAXIMUM SATURATION CHANGE IS LESS THAN BIGMIN.       G0005120
                C                  THAN BIGMIN.                                             G0005130
                C                                                                           G0005140
                C          SMALLR: FACTOR ( <=1 ) BY WHICH THE TIME STEP IS REDUCED IF    G0005150
                C                  THE MAXIMUM SATURATION CHANGE IS GREATER THAN BIGMAX.    G0005160
                C                  ALSO, IF TOO MANY MINOR ERRORS ARE DETECTED DURING       G0005170
                C                  A SEQUENCE OF ITERATIONS, THE TIME STEP IS REDUCED       G0005180
                C                  BY THE FACTOR SMALLR.                                    G0005190
                C                  ALSO, IF THE MAXIMUM NUMBER OF ITERATIONS IS REACHED     G0005200
                C                  WITHOUT CONVERGENCE, THEN THE TIME STEP IS REDUCED       G0005210
                C                  BY THE FACTOR (SMALLR*SMALLR).                           G0005220
                C                                                                           G0005230
                C          THE OTHER VARIABLES IN THIS READ STATEMENT ARE NOT USED           G0005240
                C          IN THE CURRENT VERSION OF THIS SIMULATOR.                        G0005250
                C                                                                           G0005260
ISN      321            READ (5,1407)BIGMAX,BIGMIN,BIGGER,SMALLR,CHREDU,BETAPT,BETASC      G0005270
ISN      322            WRITE(6,1407)BIGMAX,BIGMIN,BIGGER,SMALLR,CHREDU,BETAPT,BETASC      G0005280
ISN      323            WRITE(9,1407)BIGMAX,BIGMIN,BIGGER,SMALLR,CHREDU,BETAPT,BETASC      G0005290
ISN      324            IF (DOXMAX.EQ.ZERO) DOXMAX=BIGMAX*1.0D-2                           G0005300
ISN      326            IF (DOXMIN.EQ.ZERO) DOXMIN=BIGMIN*1.0D-2                           G0005310
ISN      328            BETAIN=BETAPT                                                      G0005320
ISN      329            BETRAT=(1.D0-BETAIN)/BETAIN                                        G0005330
ISN      330            HBETIN=0.5D0/BETAIN                                                G0005340
ISN      331            BESRAT=(1.D0-BETASC)/BETASC                                        G0005350
ISN      332            HBESIN=0.5D0/BETASC                                                G0005360
ISN      333     1407   FORMAT(2(1X,F4.1),2X,F5.2,2(1X,F4.2),2(1X,F3.1))                   G0005370
ISN      334            MFRNM1=MFRONT-1                                                    G0005380
                C                                                                           G0005390
ISN      335            IF (COORTR) THEN                                                   G0005400
ISN      336               CALL INPUT2(NDIMNS,.TRUE.,TRACKF,NXMAX,NOMAX,NRMAX,NFPTMX,      G0005410
                1                        NOS,NRS,NRFM,NRFP,NFPTOT,                        G0005420
                2                        DX,GLINEO,GLINER,BLOCKO,BLOCKR,FRNDIS,           G0005430
                3                        FPHV,FPJX,FPJY,FPDIST)                           G0005440
                C                 BEWARE: BLOCKO IS IN DEGREES, AND GLINEO IS IN RADIANS.  G0005450
ISN      337            ELSE                                                               G0005460
ISN      338               CALL INPUT2(NDIMNS,.FALSE.,TRACKF,NXMAX,NXMAX,NYMAX,NFPTMX,     G0005470
                1                        NX,NY,NRFM,NRFP,NFPTOT,                          G0005480
                2                        DX,GLINEX,GLINEY,BLOCKX,BLOCKY,FRNDIS,           G0005490
                3                        FPHV,FPJX,FPJY,FPDIST)                           G0005500
ISN      339            END IF                                                             G0005510
                C             I.E. CALL INPUT2(NDIMNS,COORTR,TRACKF,                        G0005520
                C                              NXMAX ,NU1MAX,NU2MAX,NFPTMX,                 G0005530
                C                              NU1S,NU2S,NRFM,NRFP,NFPTOT,                  G0005540
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                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
                C                                                                       G0005550
                CCC                             DX,GLINU1,GLINU2,BLOKU1,BLOKU2,FRNDIS,  G0005560
                CCC                             FPHV,FPJX,FPJY,FPDIST)                  G0005570
                C                                                                       G0005580
ISN      340     8005 FORMAT(1X,I2,1X,A4,1X,2I2,F13.9,2X,I2,F15.9)                      G0005590
ISN      341    80051 FORMAT(18X,D11.4)                                                 G0005600
ISN      342    80052 FORMAT(1X,'     ',1X,D11.4,1X,D11.4)                             G0005610
ISN      343    80053 FORMAT(1X,'LAST',1X,D11.4,1X,D11.4)                              G0005620
ISN      344          NFPM1=NFPTOT-1                                                   G0005630
ISN      345          IF (COORTR) THEN                                                 G0005640
ISN      346            NOSNRS=NOS*NRS                                                 G0005650
ISN      347            ELSE                                                           G0005660
ISN      348            NXNY=NX*NY                                                     G0005670
ISN      349            NXNYAU=NXNY                                                    G0005680
ISN      350            END IF                                                         G0005690
                C                                                                       G0005700
ISN      351          IF (NDIMNS.LT.2) NBLOKS=NX-1                                     G0005710
                CC          SUPERSEDES THE VALUE OF NBLOKS WHICH WAS READ FROM THE DATA. G0005720
                CC                                                                      G0005730
ISN      353          IF (COORTR) THEN                                                 G0005740
ISN      354            CENDIS=ZERO                                                    G0005750
ISN      355            DCENDS=ZERO                                                    G0005760
ISN      356            CALL DEPGRD(.TRUE.,NOMAX,NRMAX,                                G0005770
                     1                 SINTHT,COSTHT,SINTHA,COSTHA,                   G0005780
                     2                 SINIMA,COSIMA,SINIPA,COSIPA,                   G0005790
                     3                 DTHTAM,DTHTAP,DOPHMM,DTHETA,                   G0005800
                     4                 DFOMTM,DFOMTP,DRPHMM,DRADM1,DRADP1)            G0005810
                CCCCCC          I.E. CALL DEPGRD(OUTP,NOMAX,NRMAX,                      G0005820
                CCCCCC                           SINTHT,COSTHT,SINTHA,COSTHA,           G0005830
                CCCCCC                           SINIMA,COSIMA,SINIPA,COSIPA,           G0005840
                CCCCCC                           DTHTAM,DTHTAP,DOPHMM,DTHETA,           G0005850
                CCCCCC                           DFOMTM,DFOMTP,DRPHMM,DRADM1,DRADP1)    G0005860
ISN      357            END IF                                                         G0005870
                CC                                                                      G0005880
                                                                                        G0005890
ISN      358          CALL TBLGN1(.TRUE.,NVARS,NOMAX,NRMAX,                            G0005900
                     1           NBLKMX,NGRPMX,NFPTMX,NRLGMX,                         G0005910
                     2           NBLKS,NGRPS,NUS,NRLGS,JBLK,JFPT,LFRNT,JRLG,          G0005920
                     3           JGRPOG,JGRPOF,JAGPOF,JGRPOR,                         G0005930
                     4           JADJAC,JGRPIJ,IOFGRP,JOFGRP,                         G0005940
                     5           BLX,BLY,GPX,GPY)                                     G0005950
                CCCCCC          I.E. CALL TBLGN1(OUTP,NVARS,NOMAX,NRMAX,                G0005960
                CCCCCC                           NBLKMX,NGRPMX,NFPTMX,NRLGMX,           G0005970
                CCCCCC                           NBLKS,NGRPS,NUS,NRLGS,JBLK,JFPT,LFRNT,JRLG, G0005980
                CCCCCC                           JGRPOG,JGRPOF,JAGPOF,JGRPOR,           G0005990
                CCCCCC                           JADJAC,JGRPIJ,IOFGRP,JOFGRP,           G0006000
                CCCCCC                           BLX,BLY,GPX,GPY)                       G0006010
                                                                                        G0006020
ISN      359          NG=NGRPS-1                                                       G0006030
                CCC         NG     IS THE NUMBER OF GROUPS IN THE ONE-DIMENSIONAL CONTEXT, G0006040
                CCC                EXCEPT THAT NJAY IS NOT INCLUDED.                    G0006050
                CCC         NGRPS IS THE NUMBER OF GROUPS IN THE TWO-DIMENSIONAL CONTEXT, G0006060
                CCC                AND INCLUDES NJAY.                                   G0006070
                CCC         NG SHOULD NOT BE USED IN THE TWO-DIMENSIONAL CONTEXT.       G0006080
                CCC         BOTH VARIABLES MAY BE USED IN THE ONE-DIMENSIONAL CONTEXT.  G0006090
                C                                                                       G0006100
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                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
ISN      360          IF (NFPTOT.GT.0.AND..NOT.COORTR)                                 G0006110
                     1 CALL BLOKS1(NFPTMX,NGRPMX,FPDIST,                              G0006120
                     2             FPDISX,FPDISY,FPDSNM,GPX,GPY)                      G0006130
                CCCCCC          I.E. CALL SUBROUTINE BLOKS1(NFPTMX,NGRPMX,FPDIST,       G0006140
                CCCCCC                                      FPDISX,FPDISY,FPDSNM,GPX,GPY) G0006150
ISN      362          IF (NDIMNS.GE.2) THEN                                            G0006160
                C                                                                       G0006170
ISN      363            IF (COORTR) CALL TBLGN2(.TRUE.,L2SYMM,NGRPMX,                  G0006180
                     1                         JGPTNR,JTYFRN,JTYRFL,JRFLIM)           G0006190
                CCCCCC          I.E. CALL SUBROUTINE TBLGN2(OUTP,L2SYMM,NGRPMX,         G0006200
                CCCCCC                                      JGPTNR,JTYFRN,JTYRFL,JRFLIM) G0006210
                                                                                        G0006220
ISN      365            CALL TBLGN3(.TRUE.,NCONMX,NGRPMX,NBANMX,                       G0006230
                     1             NCONXS,JBDIAG,JOFSMM,JOFSMX,                       G0006240
                     2             JWORK1,JWORK2,LWORK3,                              G0006250
                     3             JCONX,JGRPOC,JNEIBR,OUTLIE,J1CONX,NNEIBS)          G0006260
                CCCCCC          I.E. CALL TBLGN3(OUTP,NCONMX,NGRPMX,NBANMX,             G0006270
                CCCCCC                           NCONXS,JBDIAG,JOFSMM,JOFSMX,           G0006280
                CCCCCC                           JWORK1,JWORK2,LWORK3,                  G0006290
                CCCCCC                           JCONX,JGRPOC,JNEIBR,OUTLIE,J1CONX,NNEIBS) G0006300
                                                                                        G0006310
ISN      366            CALL EDGGN1(.TRUE.,NDIRS,NGRPMX,NFPTMX,NDIRMX,NEDGMX,          G0006320
                     1             NEDGES,JEDGOF,EDPTNR,FREDGE,LNULED,LBNDED,         G0006330
                     2             JBLKOE,JGRPOE,JDIROE,JEDGOG,EDGOR ,EDTYPE,         G0006340
                     3             JPFPNE,JPFPPO,JPFPVE,JPFPHO,JPEDVE,JPEDHO)         G0006350
                CCCCCC          I.E. CALL EDGGN1(OUTP,NDIRS,NGRPMX,NFPTMX,NDIRMX,NEDGMX,G0006360
                CCCCCC                           NEDGES,JEDGOF,EDPTNR,FREDGE,LNULED,LBNDED, G0006370
                CCCCCC                           JBLKOE,JGRPOE,JDIROE,JEDGOG,EDGOR ,EDPARM, G0006380
                CCCCCC                           JPFPNE,JPFPPO,JPFPVE,JPFPHO,JPEDVE,JPEDHO) G0006390
                                                                                        G0006400
ISN      367            CALL EDGGN2(.TRUE.,NGRPMX,NEFCMX,NEDGMX,JORIEN,                G0006410
                     1             NEFECS,NIEDGS,J1EFEC,JIEDGE,JIGRUP,EDGOR)          G0006420
                CCCCCC          I.E. CALL EDGGN2(OUTP,NGRPMX,NEFCMX,NEDGMX,JORIEN,      G0006430
                CCCCCC                           NEFECS,NIEDGS,J1EFEC,JIEDGE,JIGRUP,EDGOR) G0006440
                                                                                        G0006450
ISN      368            END IF                                                         G0006460
ISN      369          IMAXM=IFIRST+IINTVL                                              G0006470
ISN      370          ISTIT=0                                                          G0006480
ISN      371          NJAY=NGRPS                                                       G0006490
ISN      372          NTOTPT=2*NJAY                                                    G0006500
ISN      373          NTOTSC=4*NJAY                                                    G0006510
                C     IJKLMN=0 WAS DELETED.                                            G0006520
ISN      374          DT=DTINIT                                                        G0006530
ISN      375          STORDT=DT                                                        G0006540
ISN      376          DTEX=DT                                                          G0006550
ISN      377          DDT=DT                                                           G0006560
ISN      378          DDG=(DGMIN+DGMAX)*0.5D0                                          G0006570
ISN      379          DDX=(DDXMIN+DDXMAX)*0.5D0                                        G0006580
ISN      380          IEND=IENDNL                                                      G0006590
ISN      381          DO 1417 I=1,IEND                                                 G0006600
ISN      382          ITSC(I)=0                                                        G0006610
ISN      383    1417  ITPT(I)=0                                                       G0006620
ISN      384          NITRS1=0                                                         G0006630
ISN      385          NITRS2=0                                                         G0006640
ISN      386          NITRS3=0                                                         G0006650
                                                                                        G0006660
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                 *....*...1.....2.....3.....4.....5.....6.....7.*.....8
ISN     387          CHANGE=.FALSE.                                                  G0006670
ISN     388          OVTAKE=.FALSE.                                                  G0006680
ISN     389          EQCHEK=.FALSE.                                                  G0006690
ISN     390          GAMMA1=-2.D0/DX(1)                                              G0006700
ISN     391          GAMMA2=-2.D0/DX(1)                                              G0006710
ISN     392          GAMMA3=0.D0                                                     G0006720
                                                                                     G0006730
                C                KA: THE ABSOLUTE PERMEABILITY OF THE RESERVOIR.     G0006740
                C                                                                    G0006750
                C                GX: THE X-COMPONENT OF THE GRAVITATIONAL FORCE.     G0006760
                C                                                                    G0006770
                C                GY: THE Y-COMPONENT OF THE GRAVITATIONAL FORCE.     G0006780
                C                                                                    G0006790
                C               SWC: THE CONNATE WATER SATURATION.                   G0006800
                C                                                                    G0006810
                C             SOIRR: THE IRREDUCIBLE HYDROCARBON-PHASE SATURATION.   G0006820
                C                                                                    G0006830
                C             SGIRR: THE IRREDUCIBLE VAPOUR-PHASE SATURATION.        G0006840
                C                                                                    G0006850
ISN     393          READ (5,8006)KA,GX,GY,SWC,SOIRR,SGIRR                           G0006860
ISN     394          WRITE(6,8006)KA,GX,GY,SWC,SOIRR,SGIRR                           G0006870
ISN     395          WRITE(9,8006)KA,GX,GY,SWC,SOIRR,SGIRR                           G0006880
ISN     396  8006    FORMAT(1X,D11.4,1X,2F6.2,2X,3F6.3)                              G0006890
                C                                                                    G0006900
                C       THE VARIABLES IN THE FOLLOWING 4 READ STATEMENTS ARE NOT USED G0006910
                C       IN THE CURRENT VERSION OF THIS SIMULATOR.                    G0006920
                C                                                                    G0006930
ISN     397          READ (5,8007)CUMENL,CUMMAT,CUMSVL,CUMVOL,CUMINT,CUMPVI          G0006940
ISN     398          WRITE(6,8007)CUMENL,CUMMAT,CUMSVL,CUMVOL,CUMINT,CUMPVI          G0006950
ISN     399          WRITE(9,8007)CUMENL,CUMMAT,CUMSVL,CUMVOL,CUMINT,CUMPVI          G0006960
ISN     400          READ (5,8007)CUMENG,CUMSTM,CUMSVG,CUMVOG                        G0006970
ISN     401          WRITE(6,8007)CUMENG,CUMSTM,CUMSVG,CUMVOG                        G0006980
ISN     402          WRITE(9,8007)CUMENG,CUMSTM,CUMSVG,CUMVOG                        G0006990
ISN     403  8007    FORMAT(1X,7D11.4)                                               G0007000
ISN     404          READ (5,8008)PRDENL,PRDMAT,PRDSVL,PRDVOL,PRDINT                 G0007010
ISN     405          WRITE(6,8008)PRDENL,PRDMAT,PRDSVL,PRDVOL,PRDINT                 G0007020
ISN     406          WRITE(9,8008)PRDENL,PRDMAT,PRDSVL,PRDVOL,PRDIN                  G0007030
ISN     407          READ (5,8008)PRDENG,PRDSTM,PRDSVG,PRDVOG                        G0007040
ISN     408          WRITE(6,8008)PRDENG,PRDSTM,PRDSVG,PRDVOG                        G0007050
ISN     409          WRITE(9,8008)PRDENG,PRDSTM,PRDSVG,PRDVOG                        G0007060
ISN     410  8008    FORMAT(1X,7D11.4)                                               G0007070
                                                                                     G0007080
                C                MO: THE MOLECULAR WEIGHT OF VOLATILE HYDROCARBON #1. G0007090
                C                                                                    G0007100
                C             MWOIL: THE MOLECULAR WEIGHT OF THE BITUMEN.            G0007110
                C                                                                    G0007120
                C              MSOL: THE MOLECULAR WEIGHT OF VOLATILE HYDROCARBON #2. G0007130
                C                                                                    G0007140
ISN     411          READ (5,8009)MO,MWOIL,MSOL                                      G0007150
ISN     412          WRITE(6,8009)MO,MWOIL,MSOL                                      G0007160
ISN     413          WRITE(9,8009)MO,MWOIL,MSOL                                      G0007170
ISN     414  8009    FORMAT(1X,3F7.2)                                                G0007180
ISN     415          RTMWAT=4.243D0                                                  G0007190
ISN     416          RTMOIL=DSQRT(MO)                                                G0007200
ISN     417          RTMINT=DSQRT(MWOIL)                                             G0007210
ISN     418          RTMSOL=DSQRT(MSOL)                                              G0007220
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                 *....*...1.....2.....3.....4.....5.....6.....7.*.....8
                                                                                     G0007230
                C                                                                    G0007240
                C        AO,BO,CO: PARAMETERS IN THE VAPOUR-PRESSURE EQUATION        G0007250
                C                  OF VOLATILE HYDROCARBON #1.                       G0007260
                C                                                                    G0007270
                C         HVAPO: LATENT HEAT OF VAPORIZATION                         G0007280
                C                OF VOLATILE HYDROCARBON #1 (JOULES PER KG MOLE).    G0007290
                C                                                                    G0007300
                C        UOFUDG: NOT USED IN THE CURRENT VERSION OF THIS SIMULATOR.  G0007310
                C                                                                    G0007320
ISN     419          READ (5,8010)AO,BO,CO,HVAPO,UOFUDG                              G0007330
ISN     420          WRITE(6,8010)AO,BO,CO,HVAPO,UOFUDG                              G0007340
ISN     421          WRITE(9,8010)AO,BO,CO,HVAPO,UOFUDG                              G0007350
                C                                                                    G0007360
                C        ASOL,BSOL,CSOL: PARAMETERS IN THE VAPOUR-PRESSURE EQUATION  G0007370
                C                  OF VOLATILE HYDROCARBON #2.                       G0007380
                C                                                                    G0007390
                C         HVAPSV: LATENT HEAT OF VAPORIZATION                        G0007400
                C                 OF VOLATILE HYDROCARBON #2 (JOULES PER KG MOLE).   G0007410
                C                                                                    G0007420
ISN     422          READ (5,8010)ASOL,BSOL,CSOL,HVAPSV                              G0007430
ISN     423          WRITE(6,8010)ASOL,BSOL,CSOL,HVAPSV                              G0007440
ISN     424          WRITE(9,8010)ASOL,BSOL,CSOL,HVAPSV                              G0007450
ISN     425  8010    FORMAT(1X,D14.7,2F8.2,2D12.5)                                   G0007460
                C                                                                    G0007470
                C          AW,BW: PARAMETERS IN THE VAPOUR-PRESSURE EQUATION         G0007480
                C                 OF WATER.                                          G0007490
                C                                                                    G0007500
                C         HVAPSV: LATENT HEAT OF VAPORIZATION OF WATER.              G0007510
                C                                                                    G0007520
ISN     426          AW=2.92356D-4                                                   G0007530
ISN     427          BW=4.22601D0                                                    G0007540
ISN     428          HVAPS=4.507907D7                                                G0007550
                C            THIS IS THE CORRECT VALUE FOR 0 DEGREES CELSIUS.        G0007560
                C            THE WELL-KNOWN VALUE 540 CAL/GM IS VALID                G0007570
                C            FOR 100 DEGREES CELSIUS, BUT NOT FOR 0 DEGREES CELSIUS. G0007580
ISN     429          IF (NDIMMS.LE.1) THEN                                           G0007590
ISN     430            DO 325 J=1,NJAY                                               G0007600
ISN     431              DISTX(J)=GPX(J)                                             G0007610
ISN     432              IF (J.GT.1) DX(J-1)=DISTX(J)-DISTX(J-1)                     G0007620
ISN     434      325   CONTINUE                                                      G0007630
ISN     435          END IF                                                          G0007640
ISN     436        ITIME=0                                                           G0007650
ISN     437        OUT=.FALSE.                                                       G0007660
                C          NOTE: IF OUT IS .TRUE., THEN INPUT4 SHOULD NOT CALL SATS. G0007670
                C                                                                    G0007680
ISN     438        CALL INPUT4                                                       G0007690
                C                                                                    G0007700
ISN     439        IF (ITABL.GT.0) GO TO 226                                         G0007710
                C                                                                    G0007720
ISN     440        CALL INPUT5(NMELMX,NDIRMX,NGRPMX)                                 G0007730
                C                                                                    G0007740
ISN     441        IF (.NOT.SWIT8) THEN                                              G0007750
ISN     442          SWP(4)=SWC                                                      G0007760
ISN     443          SOP(4)=SOIRR                                                    G0007770
ISN     444          SGP(4)=ONE-SWC-SOIRR                                            G0007780
ISN     445        END IF
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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
                C                                                                              G0007790
ISN      446          LCTN=2                                                                   G0007800
ISN      447          CALL TABENT(1,NGRPS,LCTN,NGRPMX,12,8,16,18,20,                           G0007810
                     1           .TRUE. ,NENTTI,TACTEM,TALMUO,TALMUN,TAMMUG,IENTTI,          G0007820
                     2           .TRUE. ,NENTXN,TABXN ,TABUOR,              ,IENTXN,         G0007830
                     3           .TRUE. ,NENTSN,TABSN ,TABKRM,TABKOM,TABPCM,IENTSN,          G0007840
                     4           .TRUE. ,NENTSL,TABSL ,TABKRG,TABKOG,TABPCV,IENTSL,          G0007850
                     5           .TRUE. ,NENTT2,STMTAB                     ,IENTT2,          G0007860
                     6           ITABL,IERR,IWRONG)                                           G0007870
                C        I.E. CALL SUBROUTINE TABENT(ISTART,IFINIS,LCTN,NGRPMX,              G0007880
                C                   NMXTI,NMXXN,NMXSN,NMXS( ,NMXT2,                         G0007890
                C                   LTI,NENTTI,TACTEM,TALMUO,TALMUN,TAMMUG,IENTTI,           G0007900
                C                   LXN,NENTXN,TABXN ,TABUOR,              ,IENTXN,          G0007910
                C                   LSN,NENTSN,TABSN ,TABKRM,TABKOM,TABPCM,IENTSN,           G0007920
                C                   LSL,NENTSL,TABSL ,TABKRG,TABKOG,TABPCV,IENTSL,           G0007930
                C                   LT2,NENTT2,STMTAB                     ,IENTT2,           G0007940
                C                   ITABL,IERR,IWRONG)                                       G0007950
                C                                                                            G0007960
                C                                                                            G0007970
                C           I.E. CALL BLOKS2(OUTP,NBLKMX,BLCORX,BLCORY,BLSPEC,               G0007980
                C                            LCAREA,BLAREA)                                  G0007990
                C                                                                            G0008000
                C           I.E. CALL EDGCLC(NEDGMX,NBNDMX,                                  G0008010
                C                            EDSTAX,EDSTAY,EDFINX,EDFINY,FLFR)               G0008020
                C                                                                            G0008030
ISN      448          IF (NDIMNS.LE.1) THEN                                                  G0008040
ISN      449             RCONDL=RCOND(1)                                                     G0008050
ISN      450             RCONDR=RCOND(2)                                                     G0008060
                C              RCONDL IS TRUE IF THE INJECTION RATE IS SPECIFIED AT POINT#1  G0008070
                C                             FALSE IF THE PRESSURE IS SPECIFIED AT POINT#1. G0008080
                C              RCONDR IS TRUE IF P(NG) IS ALLOWED TO FLOAT.                  G0008090
                C                             FALSE IF P(NG) IS KEPT AT A PARTICULAR VALUE.  G0008100
ISN      451             IF (RCONDL) RATEL=FSPEC(1)                                          G0008110
ISN      453             IF (RCONDR) RATER=FSPEC(2)                                          G0008120
ISN      455             IF (.NOT.RCONDL) PSPECL=PSPEC(1)                                    G0008130
ISN      457             IF (.NOT.RCONDR) PSPECR=PSPEC(2)                                    G0008140
ISN      459             TSPECL=TSPEC(1)                                                     G0008150
ISN      460             IF (RCONDL) AINJV=RATEL                                             G0008160
                C              IF RCONDL IS .FALSE., AINJV WILL BE CALCULATED AFTER          G0008170
                C              PROPTY IS CALLED.                                             G0008180
ISN      462             IF (RCONDR) PRODV=RATER                                             G0008190
                C            THE PRODUCTION RATE, IF SPECIFIED, MUST BE BY VOLUME, OR ELSE.  G0008200
                C              IF RCONDR IS FALSE, PRODV CANNOT BE ESTIMATED UNTIL PROPTY    G0008210
                C              IS CALLED.                                                    G0008220
ISN      464           END IF                                                                G0008230
                C                                                                            G0008240
                C                                                                            G0008250
                C        2.  CALCULATION OF PHYSICAL PROPERTIES                              G0008260
                C                                                                            G0008270
                C                                                                            G0008280
ISN      465           DO 304 JG=1,NGRPS                                                     G0008290
ISN      466              JGRPJ=JG                                                           G0008300
                C                THIS USE OF BOTH JG AND JGRPJ ELIMINATES A SPURIOUS         G0008310
                C                MESSAGE FROM THE CRAY CFT COMPILER.                         G0008320
ISN      467              CALL SUPROP(JGRPJ,5)                                               G0008330
                C                                                                            G0008340
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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
                C              I.E. CALL SUBROUTINE SUPROP(JGRPJ,LCTNPW)                     G0008350
ISN      468              IF (IERR.NE.0) GO TO 218                                           G0008360
ISN      469        304 CONTINUE                                                             G0008370
                C                                                                            G0008380
                C                                                                            G0008390
ISN      470           IF (NDIMNS.GE.2.AND..NOT.COORTR) THEN                                 G0008400
ISN      471              DO 306 JB=1,NBNDBS                                                 G0008410
                C                IF RCOND(JB) IS TRUE, THEN BVFLOW(JB) SHOULD REMAIN         G0008420
                C                FIXED AT THE VALUE TO WHICH IT WAS SET IN INPUT5.           G0008430
ISN      472                 IF (.NOT.RCOND(JB)) THEN                                        G0008440
ISN      473                    JGRB =JGRPOG(JBLKOB(JB))                                     G0008450
ISN      474                    JGRINT=JGRPOG(JINTOB(JB))                                    G0008460
ISN      475                    DIST=DMAX1(DABS(GPX(JGRB)-GPX(JGRINT)),                      G0008470
                     1                        DABS(GPY(JGRB)-GPY(JGRINT)))                 G0008480
ISN      476                    BVFLOW(JB)=MOBT(JB)*(P(JGRB)-P(JGRINT))/DIST                 G0008490
ISN      477                    IF (DABS(BVFLOW(JB)).LT.(MOBT(JB)/DIST))                     G0008500
                     1              BVFLOW(JB)=1.00+&*MOBT(JB)/DIST                         G0008510
                C                    10,000 PASCALS IS A REASONABLE, GENTLE PRESSURE DROP.   G0008520
                C                    THE SIGN OF THE ABOVE EXPRESSION MIGHT BE WRONG,        G0008530
                C                    BUT THE CORRECT SIGN PROBABLY CANNOT BE DETERMINED      G0008540
                C                    EASILY FROM THE INITIAL CONDITIONS.                     G0008550
ISN      479                 END IF                                                          G0008560
ISN      480        306    CONTINUE                                                         G0008570
ISN      481           END IF                                                               G0008580
                C                                                                            G0008590
ISN      482           IF (NDIMNS.LE.1) THEN                                                G0008600
ISN      483              OUT=.FALSE.                                                       G0008610
ISN      484              IF (P(NG).GT.P(1)) OUT=.TRUE.                                     G0008620
ISN      486              IF (.NOT.RCONDL) AINJV=-MOBTL*((P(2)-P(1))/DX(1)) *               G0008630
                     1  ((ONE-VAPINJ(1)) + VAPINJ(1) * ((DGP(1)+DGP(2))/(UGP(1)+UGP(2)))) G0008640
                     2                               * (UGP(1)/DGP(1))                    G0008650
ISN      488              IF (.NOT.RCONDR) PRODV=-MOBTR*(P(NG)-P(NG-1))/DX(NG-1)          G0008660
ISN      490           END IF                                                               G0008670
                C                                                                            G0008680
ISN      491           DO 308 I=1,NGRPS                                                     G0008690
ISN      492           OP(I)=P(I)                                                           G0008700
ISN      493           OSGP(I)=SGP(I)                                                       G0008710
ISN      494           OSOP(I)=SOP(I)                                                       G0008720
ISN      495           OYMOLE(2,I)=YMOLE(2,I)                                               G0008730
ISN      496           OYMOLE(1,I)=YMOLE(1,I)                                               G0008740
ISN      497           OYMOLE(4,I)=YMOLE(4,I)                                               G0008750
ISN      498           OT(I) =T(I)                                                          G0008760
ISN      499           OSWP(I)=SWP(I)                                                       G0008770
ISN      500           FRDSW(I)=0.5D0                                                       G0008780
ISN      501           OR(I)=R(I)                                                           G0008790
ISN      502           OD(I)=D(I)                                                           G0008800
ISN      503           OV(I)=V(I)                                                           G0008810
ISN      504           OXMOLE(1,I)=XMOLE(1,I)                                               G0008820
ISN      505           OXMOLE(3,I)=XMOLE(3,I)                                               G0008830
ISN      506           OXMOLE(2,I)=XMOLE(2,I)                                               G0008840
ISN      507           OPHI(I)=PHI(I)                                                       G0008850
ISN      508           OIENTI(I)=IENTTI(I)                                                  G0008860
ISN      509           OIENXN(I)=IENTXN(I)                                                  G0008870
ISN      510           OIENSN(I)=IENTSN(I)                                                  G0008880
ISN      511           OIENSL(I)=IENTSL(I)                                                  G0008890
ISN      512           OOGP(I)=OGP(I)                                                       G0008900
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                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
ISN     513           ODMP(I)=DMP(I)                                                  G0008910
ISN     514           ODOP(I)=DOP(I)                                                  G0008920
ISN     515       308 CONTINUE                                                        G0008930
ISN     516           IF (NDIMNS.LE.1) THEN                                           G0008940
ISN     517             DO 316 I=1,MJAY                                               G0008950
                C               DEFINE ODISTX EVEN IF THERE IS NO FRONT-TRACKING.
ISN     518               ODISTX(I)=DISTX(I)                                          G0008970
ISN     519       316     CONTINUE                                                    G0008980
ISN     520             SUM=ZERO                                                      G0008990
ISN     521             DO 320 I=2,MG                                                 G0009000
ISN     522               IM1=I-1                                                     G0009010
ISN     523               SUM=SUM+DX(IM1)*0.5D0*(PHI(IM1)+PHI(I))                     G0009020
ISN     524       320     CONTINUE                                                    G0009030
ISN     525             PORVOL=SUM                                                    G0009040
ISN     526             FRDSM(1)=ONE                                                  G0009050
ISN     527             ODISXM=ODISTX(MFRONT)                                         G0009060
ISN     528             OPRODV=PRODV                                                  G0009070
ISN     529             OAINJV=AINJV                                                  G0009080
                C             OMOBGL=MOBGL WAS DELETED.                               G0009090
                C             OMOBML=MOBML WAS DELETED.                               G0009100
                C             OMOBOL=MOBOL WAS DELETED.                               G0009110
                C             OMOBTL=MOBTL WAS DELETED.                               G0009120
                C             OMOBGR=MOBGR WAS DELETED.                               G0009130
                C             OMOBMR=MOBMR WAS DELETED.                               G0009140
                C             OMOBOR=MOBOR WAS DELETED.                               G0009150
                C             OMOBTR=MOBTR WAS DELETED.                               G0009160
ISN     530           END IF                                                          G0009170
                C                                                                     G0009180
ISN     531         IF (NDIMNS.GE.2) THEN                                             G0009190
                C                                                                     G0009200
ISN     532           CALL EQCDCL(.TRUE.,.FALSE.,NCOMPS,NBALNS,                       G0009210
                     1            NOMAX,NGRPMX,NEDGMX,                                G0009220
                     2            VFDOTM,CONCL,CONCV,FLTMTO,                          G0009230
                     3            IEQCOD)                                             G0009240
                C               I.E. CALL EQCDCL(LEINIT,LOUTP,NCOMPS,NBALNS,          G0009250
                C                                NOMAX,NGRPMX,NEDGMX,                 G0009260
                C                                VFDOTM,CONCL,CONCV,FLTMTO,           G0009270
                C                                IEQCOD)                              G0009280
                C                                                                     G0009290
ISN     533           DO 358 JEDGEJ=1,NEDGES                                          G0009300
ISN     534             DO 356 IBALN=1,NBALNS                                         G0009310
ISN     535               FLTMTO(IBALN,JEDGEJ)=ZERO                                   G0009320
ISN     536       356     CONTINUE                                                    G0009330
ISN     537       358   CONTINUE                                                      G0009340
ISN     538           NCALCS=NGRPS                                                    G0009350
ISN     539           DO 362 JCALC=1,NCALCS                                           G0009360
ISN     540             GRPLIS(JCALC)=JCALC                                           G0009370
ISN     541       362   CONTINUE                                                      G0009380
                C                                                                     G0009390
ISN     542           CALL ACUMCL(.TRUE.,.TRUE.,.TRUE.,                               G0009400
                     1            NFPTMX,NGRPMX,NATRMX,NCOMPS,NBALNS,                 G0009410
                     2            NCALCS,GRPLIS,ENHCFO,VOLCFO,                        G0009420
                     3            CONCL,CONCV,SCAREA,ACCUMO,ACUMFO)                   G0009430
                C               I.E. CALL ACUMCL(ALGRPS,INITLZ,TEST                   G0009440
                C                                NFPTMX,NGRPMX,NATRMX,NCOMPS,NBALNS,  G0009450
                C                                NCALCS,GRPLIS,ENHCF,VOLCF,           G0009460
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                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
                C                                CONCL,CONCV,SCAREA,ACCUM,ACUMF)      G0009470
                C                                                                     G0009480
                C                                                                     G0009490
ISN     543           DO 374 JGRPJ=1,NGRPS                                            G0009500
ISN     544             DO 372 ICOMPO=1,NCOMPS                                        G0009510
ISN     545               OCONCL(ICOMPO,JGRPJ)=CONCL(ICOMPO,JGRPJ)                    G0009520
ISN     546               OCONCV(ICOMPO,JGRPJ)=CONCV(ICOMPO,JGRPJ)                    G0009530
ISN     547       372     CONTINUE                                                    G0009540
ISN     548       374   CONTINUE                                                      G0009550
ISN     549           DO 384 JB=1,NBNDBS                                              G0009560
ISN     550             OBVFLO(JB)=BVFLOW(JB)                                         G0009570
ISN     551       384   CONTINUE                                                      G0009580
ISN     552           IF (COORTR) THEN                                                G0009590
ISN     553             DO 386 JO=1,NOS                                               G0009600
ISN     554               OFRNDS(JO)=FRNDIS(JO)                                       G0009610
ISN     555       386     CONTINUE                                                    G0009620
ISN     556             VFFCTR=1.00-8                                                 G0009630
ISN     557           END IF                                                          G0009640
ISN     558         END IF                                                            G0009650
ISN     559         WRITE(6,118)III,JK,(TITLE(I),I=1,18)                              G0009660
ISN     560         WRITE(9,118)III,JK,(TITLE(I),I=1,18)                              G0009670
ISN     561     118 FORMAT('1',10X,'SIMULATION NUMBER ',I2,'  - ',18A4)               G0009680
ISN     562         ITERAT=0                                                          G0009690
ISN     563         ITIME=0                                                           G0009700
ISN     564         IF (BYHEIT) GO TO 228                                             G0009710
ISN     565         DOXMNP=DOXMIN*1.002                                               G0009720
ISN     566         DOXMXP=DOXMAX*1.002                                               G0009730
ISN     567         IF (TRACKF) WRITE(6,5152)DOXMNP,DOXMXP,BIGGER,SMALLR              G0009740
ISN     569         IF (TRACKF) WRITE(9,5152)DOXMNP,DOXMXP,BIGGER,SMALLR              G0009750
ISN     571     5152 FORMAT('0',//1X,'ALLOWABLE RANGE OF THE DIMENSIONLESS MOTION OF THG0009760
                    1E FRONT OVER ONE TIME STEP IS ',F3.1,' TO ',F3.1,' PERCENT',/1X,'IF LARGEST CHANGE ISG0009770
                    2      F3.1,' TO ',F3.1,' PERCENT',/1X,'IF LARGEST CHANGE ISG0009780
                    3 ABOVE//BELOW THIS RANGE', CHANGE TIME STEP BY FACTOR OF ',F4.2,G0009790
                    4'//' (F4.2)                                                      G0009800
ISN     572         WRITE(6,5154)BIGMIN,BIGMAX,BIGGER,SMALLR                          G0009810
ISN     573         WRITE(9,5154)BIGMIN,BIGMAX,BIGGER,SMALLR                          G0009820
ISN     574     5154 FORMAT('0',//1X,'ALLOWABLE RANGE OF SATURATION CHANGES OVER ONE TIG0009830
                    1ME STEP IS ',F3.1,' TO ',F3.1,' PERCENT',/1X,'IF LARGEST CHANGE ISG0009840
                    2 ABOVE//BELOW THIS RANGE', CHANGE TIME STEP BY FACTOR OF ',F4.2,G0009850
                    3'//' (F4.2)                                                      G0009860
ISN     575         WRITE(6,5155)TOL1,TOL                                             G0009870
ISN     576         WRITE(9,5155)TOL1,TOL                                             G0009880
ISN     577     5155 FORMAT('0',' CONVERGENCE LIMITS ON ITERATIVE SOLUTIONS ARE :  PRESG0009890
                    1SURE-TEMPERATURE ',F5.3,' PERCENT ; SATURATION-COMPOSITION ',     G0009900
                    2F5.3,' PERCENT')                                                 G0009910
                C                                                                     G0009920
                C                    ********************************             G0009930
                C                    ***** BEGINNING OF TIME LEVEL N *****         G0009940
                C                    ********************************             G0009950
                C                                                                     G0009960
ISN     578         DO 11111 ITIME=1,10000                                            G0009970
ISN     579         JCTEST=.FALSE.                                                    G0009980
ISN     580         JTIMIT=.TRUE.                                                     G0009990
ISN     581         REPEPT=.FALSE.                                                    G0010000
ISN     582         REPESC=.FALSE.                                                    G0010010
ISN     583         REPEAT=.FALSE.                                                    G0010020
ISN     584         CLOSE=.FALSE.
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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
ISN      585            ERRSCO=0                                                                 G0010030
ISN      586            IERRCT=0                                                                 G0010040
ISN      587            IERRPR=1                                                                 G0010050
ISN      588            BACKUP=.FALSE.                                                           G0010060
ISN      589     1992   CONTINUE                                                                 G0010070
ISN      590            VOUCPT=.FALSE.                                                           G0010080
ISN      591            VOUCSC=.FALSE.                                                           G0010090
ISN      592            IF (NDIMMS.LE.1) REPEAT=REPEPT.OR.REPESC                                 G0010100
                C  DTEX IS WHAT I EXPECT DT TO BE, EVENTUALLY.                                   G0010110
ISN      594            DTEX=DT                                                                  G0010120
ISN      595            IF ((EQCHEK.AND.(CHANGE.OR.OVTAKE)).OR.BACKUP.OR.CLOSE) GO TO 1991       G0010130
                C  NOTE: NONE OF THE VARIABLES WITH SUFFIX EX, EXCEPT DTEX,                      G0010140
                C  SEEM TO BE USED FOR ANYTHING.                                                 G0010150
ISN      596            IF (BIG.GT.BIGMAX.OR.DOX.GT.DOXMAX) DTEX=DTEX*SMALLR                     G0010160
ISN      598            IF ((BIG.LT.BIGMIN.OR.DOX.LT.DOXMIN)                                     G0010170
                     1      .AND..NOT.EQCHEK.AND.ITERAT.LT.MAXO(6,IENDNL/2))                   G0010180
                     2  DTEX=DTEX*BIGGER                                                         G0010190
ISN      600            IF (DTEX.GT.DTMAX) DTEX=DTMAX                                            G0010200
ISN      602     1991   CONTINUE                                                                 G0010210
ISN      603            ICHECK=5                                                                 G0010220
ISN      604            WRITE(6,47101)DTEX,DT,STORDT,ODT,ICHECK                                  G0010230
ISN      605            IF (ITIME.EQ.1.AND..NOT.BACKUP)                                          G0010240
                     1WRITE(9,47101)DTEX,DT,STORDT,ODT,ICHECK                                    G0010250
ISN      607    47101 FORMAT('   DTEX=',F12.3,'   DT=',F12.3,'  STORDT=',F12.3,                  G0010260
                     1       '   ODT=',F12.3,'  AT CHECKPOINT ',I1)                             G0010270
                C          ODT IS FOR CALCULATING DTRATI.                                       G0010280
                C       STORDT IS FOR BEING PRINTED BY OUTPT1.                                  G0010290
ISN      608            IF (NDIMMS.LE.1) THEN                                                    G0010300
ISN      609               OUT=.FALSE.                                                           G0010310
ISN      610               IF (P(NG).GT.P(1)) OUT=.TRUE.                                         G0010320
ISN      612               PGRDNT=(P(2)-P(1))/DX(1)                                              G0010330
ISN      613               VLCTY=0.D0                                                            G0010340
ISN      614               VLCTY=1.D-5                                                           G0010350
ISN      615               IF((VAPINJ(1).LE.1.D-5).AND..NOT.OUT)EQUIL(1)=.FALSE.                 G0010360
ISN      617               IF(.NOT.OUT.AND.(VAPINJ(1).GT.1.D-5))EQUIL(1)=.TRUE.                  G0010370
ISN      619               EQUIL(NJAY)=.FALSE.                                                   G0010380
                C                                                                               G0010390
                C     4.  CALCULATION OF VELOCITIES & CUMULATIVE FLUXES AT END OF STEP N-1       G0010400
                C                                                                               G0010410
ISN      620               FSHORT=((EQCHEK.AND.(CHANGE.OR.OVTAKE)).OR.BACKUP.OR.CLOSE)           G0010420
                C          IF (FSHORT.OR..NOT.BACKUP) GO TO 47109 WAS DELETED.                  G0010430
                C47103    FORMAT(' *** GOTCHA!! YOU WERE JUST ABOUT TO CALL THE '               G0010440
                C        1   ' FULL VERSION OF FLUXES AFTER BACKING UP!') ALL DELETED.          G0010450
                C          WRITE(6,47103) WAS DELETED.                                          G0010460
                C            THE FOLLOWING STATEMENT REMAINS WHEN THE REST OF THIS              G0010470
                C            IS DELETED.  THIS COMMENT IS NOW NULL AND VOID.                    G0010480
                C          FSHORT=BACKUP WAS DELETED.                                           G0010490
                C47109    CONTINUE WAS DELETED.                                                 G0010500
                C                                                                               G0010510
ISN      621               TOTINJ=AINJV                                                          G0010520
                C            IF ONLY THIS CALL TO FLUXES COULD BE MOVED TO AFTER 1999,          G0010530
                C            THEN IT WOULD NOT BE NECESSARY TO DEFINE AND USE DTEX.             G0010540
                C                                                                               G0010550
                C          4.3  CALCULATE LEVEL N-1 COEFFICIENTS.                               G0010560
                C                                                                               G0010570
ISN      622     1994      CONTINUE                                                              G0010580
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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
ISN      623               IF (.NOT.TRACKF) GO TO 395                                            G0010590
ISN      624               ODISXM=DISTX(MFRONT)                                                  G0010600
ISN      625               DO 394 ICASE=1,4                                                      G0010610
ISN      626               IDISP=ICASE-2                                                         G0010620
ISN      627               I=MFRONT+IDISP                                                        G0010630
                C          DO 391 IK=1,9 WAS DELETED.                                           G0010640
                C          OACUMB(IK,ICASE)=ZERO WAS DELETED.                                   G0010650
                C   391    CONTINUE WAS DELETED.                                                G0010660
                C             THE  FIRST ".FALSE." IS PASSED TO ALLSIX.                         G0010670
                C             THE SECOND ".FALSE." IS PASSED TO PTURBD.                         G0010680
                C          DO 392 IK=1,9 WAS DELETED.                                           G0010690
                C          OACUMB(IK,ICASE)=BALEQN(IK) WAS DELETED.                             G0010700
                C   392    CONTINUE WAS DELETED.                                                G0010710
ISN      628       394     CONTINUE                                                              G0010720
ISN      629       395     CONTINUE                                                              G0010730
ISN      630               DO 405 I=1,NG                                                         G0010740
ISN      631               BOUNLF=I.EQ.1                                                         G0010750
ISN      632               BOUNRT=I.GE.NG                                                        G0010760
ISN      633               IP1=I+1                                                               G0010770
ISN      634               IF (BOUNRT) IP1=I                                                     G0010780
ISN      636               IM1=I-1                                                               G0010790
ISN      637               IF (BOUNLF) IM1=I                                                     G0010800
ISN      639               UPPLUS=IP1                                                            G0010810
ISN      640               UPMIN=IM1                                                             G0010820
ISN      641               PI  =P(I)                                                             G0010830
ISN      642               PIP1=P(IP1)                                                           G0010840
ISN      643               PIM1=P(IM1)                                                           G0010850
ISN      644               IF (P(I).GE.P(IM1).OR.BOUNLF) UPMIN=I                                 G0010860
ISN      646               IF (P(I).LE.P(IP1).OR.BOUNRT) UPPLUS=I                                G0010870
ISN      648               DXSUM=DX(I)+DX(IM1)                                                   G0010880
ISN      649               IF (BOUNLF) DXSUM=DX(I)                                               G0010890
ISN      651               IF (BOUNRT) DXSUM=DX(IM1)                                             G0010900
ISN      653               IF (TRACKF.AND.I.EQ.MFRONT-1) DXSUM=DXSUM+DX(IP1)                     G0010910
                C             THIS IS FOR WHEN THE FRONT OVERTAKES A FIXED GRID POINT,          G0010920
                C             AND POINT M-1 BECOMES POINT M-2 WITH DIFFERENT FORMULAE.          G0010930
ISN      655               DUPIM1=ZERO                                                           G0010940
ISN      656               DUPIP1=ZERO                                                           G0010950
ISN      657               IF (PIM1.GT.PI) DUPIM1=ONE                                            G0010960
ISN      659               IF (PIP1.GT.PI) DUPIP1=ONE                                            G0010970
                C             LIST OF PLACES WHERE THE SAME DEFINITIONS OF DUPIM1               G0010980
                C             AND DUPIP1 SHOULD BE USED:                                        G0010990
                C                MAIN  , LINES 243.1 /243.4                                     G0011000
                C                LOCBAL, LINES 777.64/777.67                                    G0011010
                C                PTEQNS, LINES 107.82/107.88                                    G0011020
                C                TAUYC , LINES 101    /104                                      G0011030
                C                                                                               G0011040
                C             I.E. CALL TAUYC(I,IDRYCD,ITAUCD) .                                G0011050
                C                                                                               G0011060
ISN      661               IF(I.NE.2)GO TO 7050                                                  G0011070
ISN      662               YS1PTS=YSIMH                                                          G0011080
ISN      663               KO1PTS=KOIMH                                                          G0011090
ISN      664               KS1PTS=KSIMH                                                          G0011100
ISN      665               YS2PTS=YSIPH                                                          G0011110
ISN      666               KO2PTS=KOIPH                                                          G0011120
ISN      667               KS2PTS=KSIPH                                                          G0011130
ISN      668    7050       CONTINUE                                                              G0011140
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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
                C          TAUMP1=(DM(I)+DM(IP1))*KA*KRH(UPPLUS)/(UM(I)+UM(IP1)) DELETED. G0011150
                C          TAUMP2=(DM(I)+DM(IM1))*KA*KRH(UPMIN  )/(UM(I)+UM(IM1)) DELETED. G0011160
                C          TAUOP1=(DOP(I)+DOP(IP1))*KA*KROP(UPPLUS)/(UOP(I)+UOP(IP1)) DLTDG0011170
                C          TAUOP2=(DOP(I)+DOP(IM1))*KA*KROP(UPMIN  )/(UOP(I)+UOP(IM1)) DLTDG0011180
                C          IF (OUT.OR..NOT.BOUNLF) GO TO 436 WAS DELETED.                 G0011190
                C          TAUMP2=MOBTL*MAT(NJ*DM(I)  WAS DELETED.                        G0011200
                C          TAUOP2=MOBTL* MC(NJ*DOP(I) WAS DELETED.                        G0011210
                C 436      CONTINUE WAS DELETED.                                          G0011220
ISN      669               DMPINV=ONE/DMP(I)                                              G0011230
ISN      670               DGPINV=ONE/DGP(I)                                              G0011240
ISN      671               DOPINV=ONE/DOP(I)                                              G0011250
ISN      672               PI=P(I)                                                        G0011260
ISN      673               TI=T(I)                                                        G0011270
ISN      674               DPDX1=(PI-P(IM1))/DX(IM1)                                      G0011280
ISN      675               IF (BOUNLF) DPDX1=-AINJV/MOBTL                                 G0011290
ISN      677               DPDX2=(P(IP1)-PI)/DX(I)                                        G0011300
ISN      678               IF (BOUNRT) DPDX2=-PRODV/MOBTR                                 G0011310
                C             THIS WON'T WORK IF BETA IS NOT ONE.                         G0011320
                C                                                                         G0011330
ISN      680               STAB1=0.5D0*DTEX                                               G0011340
ISN      681               STAB2=STAB1/DXSUM**2.000                                       G0011350
                C          C13(I) = BETRAT *  WAS DELETED.                                G0011360
                C     1       (STAB2/STAB1*(TAUGP1*YDIP**DPDX2-TAUGP2*YDIM**DPDX1)-D(I)) G0011370
                C          C14(I) = BETRAT *  WAS DELETED.                                G0011380
                C     1       (STAB2/STAB1*(TAUGP1*YVIP**DPDX2-TAUGP2*YVIM**DPDX1)-V(I)) G0011390
                C          C19(I) = BETRAT *  WAS DELETED.                                G0011400
                C     1       (STAB2/STAB1*(TAUGP1*YSIP**DPDX2-TAUGP2*YSIM**DPDX1)-R(I)) G0011410
                C             WAS ALL DELETED.                                            G0011420
ISN      682               GASLC=PHI(I)*DGP(I)*SGP(I)/(BETAPT*DTEX)                       G0011430
                C          R2(I)=BETRAT*STAB2/STAB1*(TAUGP1*YSIP**DPDX2-TAUGP2*YSIM**DPDX1)G0011440
                C     1       + MBETIN/STAB1*PHI(I)*DGP(I)*SGP(I)*YS(I) - BETRAT*R(I)     G0011450
                C          IF (EQUIL(I)) GO TO 445  WAS ALL DELETED.                      G0011460
                C          R2(I) = MBETIN/STAB1*PHI(I)*DGP(I)*SGP(I)*YS(I) - BETRAT*R(I)  G0011470
                C             SHOULD THE SGP(I) TERM BE INCLUDED?                         G0011480
                C          IF(EQUIL(I+1))R2(I)=R2(I)+BETRAT*STAB2/STAB1*TAUGP1*YSIP**DPDX2G0011490
                C          IF(EQUIL(I-1))R2(I)=R2(I)-BETRAT*STAB2/STAB1*TAUGP2*YSIM**DPDX1G0011500
                C445       CONTINUE  WAS ALL DELETED.                                     G0011510
                C          IF(R(I).EQ.0.D0)R2(I)=0.D0 WAS DELETED.                        G0011520
                C          C18(I)=BETRAT*(  WAS DELETED.                                  G0011530
                C     1    STAB2*( (TAUMP1*DMPINV+TAUOP1*DOPINV+TAUGP1*DGPINV)*DPDX2      G0011540
                C     2          - (TAUMP2*DMPINV+TAUOP2*DOPINV+TAUGP2*DGPINV)*DPDX1)     G0011550
                C     3       + STAB1*(R(I)*(DMPINV-DGPINV)+(D(I)+V(I))*(DOPINV-DGPINV)))G0011560
                C             WAS ALL DELETED.                                            G0011570
                C                                                                         G0011580
                C                                                                         G0011590
ISN      683               STAB1=ONE/DXSUM                                                G0011600
ISN      684               STAB2=STAB1/DX(I)                                              G0011610
ISN      685               STAB3=STAB1/DX(IM1)                                            G0011620
ISN      686               CMI=CMP(I)                                                     G0011630
ISN      687               COI=COP(I)                                                     G0011640
ISN      688               CGI=CGP(I)                                                     G0011650
ISN      689               HVIP1=DUPIP1*LAMBDA(IP1)+(ONE-DUPIP1)*LAMBDA(I)                G0011660
ISN      690               HVIM1=DUPIM1*LAMBDA(IM1)+(ONE-DUPIM1)*LAMBDA(I)                G0011670
                C          HVIP1=YSIP**HVAPS+YOIP**HVAPO+YVIP**HVAPSV WAS DELETED.        G0011680
                C          HVIM1=YSIM**HVAPS+YOIM**HVAPO+YVIM**HVAPSV WAS DELETED.        G0011690
                C             WARNING: THE FOLLOWING TWO STATEMENTS                       G0011700
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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
                C             CONSTITUTE A DANGEROUS KLUDGE.                              G0011710
                C             THEY ARE SAFE AS LONG AS LAMBDA IS CONSTANT EVERYWHERE.     G0011720
                C             HOWEVER, IF LAMBDA VARIES FROM POINT TO POINT, THEY WILL    G0011730
                C             SURELY CAUSE ENTHALPY BALANCE PROBLEMS.                     G0011740
                C          HVIP1=LAMBDA(I) WAS DELETED.                                   G0011750
                C          HVIM1=LAMBDA(I) WAS DELETED.                                   G0011760
                C          IF(EQUIL(I))GO TO 1905 WAS DELETED.                            G0011770
                C          IF(P(IP1).GT.P(I).AND.EQUIL(IP1))LAMBDA(I)=HVIP1 WAS DELETED.  G0011780
                C          IF(P(IM1).GE.P(I).AND.EQUIL(IM1))LAMBDA(I)=HVIM1 WAS DELETED.  G0011790
ISN      691    1905       CONTINUE                                                       G0011800
                C          H1(I)=STAB2*TAUGP1*(LAMBDA(I)-HVIP1) WAS DELETED.              G0011810
                C          H3(I)=STAB3*TAUGP2*(LAMBDA(I)-HVIM1) WAS DELETED.              G0011820
                C          H7(I)=-0.5D0*STAB2*(TAUMP1*CM(UPPLUS)+TAUOP1*COP(UPPLUS)       G0011830
                C     1      +TAUGP1*CGP(UPPLUS)) WAS ALL DELETED.                        G0011840
                C          X3=STAB2*(TAUMP1*CMI+TAUOP1*COI+TAUGP1*CGI) WAS DELETED.       G0011850
                C          H11(I)=0.5D0*STAB3*(TAUMP2*CM(UPMIN)+TAUOP2*COP(UPMIN)         G0011860
                C     1      +TAUGP2*CGP(UPMIN)) WAS ALL DELETED.                         G0011870
                C          X4=STAB3*(TAUMP2*CMI+TAUOP2*COI+TAUGP2*CGI) WAS DELETED.       G0011880
                C          H17(I)=0.5D0*(CMI-CGI) WAS DELETED.                            G0011890
                C          H18(I)=0.5D0*(COI-CGI) WAS DELETED.                            G0011900
ISN      692               X1=(0.5D0/BETAIM)*PHI(I)/DTEX*                                 G0011910
                C     1         (SMP(I)*DMP(I)*CMI+SOP(I)*DOP(I)*COI+SGP(I)*DGP(I)*CGI)  G0011920
ISN      693               X2=(0.5D0/BETAIM)*(1.D0-PHI(I))/DTEX*DBCB(I)                   G0011930
                C          H5(I) = X1 WAS DELETED.                                        G0011940
                C     1     +BETRAT*(  (X3*DPDX2*DX(I)-X4*DPDX1*DX(IM1)) WAS DELETED.      G0011950
                C     2               +H17(I)*R(I)+H18(I)*D(I)+H19(I)*V(I)  ) WAS DELETED. G0011960
                C     1     +BETRAT*( - 0.5D0*(HVAPS*R(I)+HVAPO*D(I)+HVAPSV*V(I))          G0011970
                C     2     +H7(I)*DPDX2*DX(I)*(T(IP1)+TI)+H11(I)*DPDX1*DX(IM1)*(TI+T(IM1))G0011980
                C     3           - KC(I)*STAB1*((T(IP1)-TI)/DX(I)-(TI-T(IM1))/DX(IM1))    G0011990
                C     4           + H1(I)*DX(I)*DPDX2 - H3(I)*DX(IM1)*DPDX1        )       G0012000
                C                                     WAS ALL DELETED.                    G0012010
                C                                                                         G0012020
                C             H20 SEEMS TO BE O.K. AT THE BOUNDARIES.                     G0012030
                C                                                                         G0012040
ISN      694               STAB2=DTEX/(PHI(I)*DXSUM)                                      G0012050
ISN      695      751      CONTINUE                                                       G0012060
ISN      696               IF (BOUNLF) GO TO 755                                          G0012070
                C                IF I=1, GC37,GC18, GC27, GC35 ARE NOT USED.              G0012080
                C             THEREFORE, YOIM*H ALWAYS EQUALS KOIM**XMOLE(1,UPMIN), ETC.  G0012090
ISN      697      755      CONTINUE                                                       G0012100
ISN      698               IF (SMITS) GO TO 404                                           G0012110
ISN      699               WIDTH=0.5D0*(DX(I)+DX(IM1))                                    G0012120
ISN      700               IF (BOUNLF) WIDTH=0.5D0*DX(I)                                  G0012130
ISN      702               IF (BOUNRT) WIDTH=0.5D0*DX(IM1)                                G0012140
ISN      704               IF (.NOT.TRACKF).OR.(IABS(I-MFRONT).GT.1)) GO TO 765           G0012150
ISN      705               IF (I.EQ.MFRONT-1) WIDTH=WIDTH+0.5D0*DX(I)                     G0012160
ISN      707               IF (I.EQ.MFRONT)   WIDTH=ZERO                                  G0012170
ISN      709               IF (I.EQ.MFRONT+1) WIDTH=WIDTH+0.5D0*DX(IM1)                   G0012180
ISN      711      765      CONTINUE                                                       G0012190
ISN      712               TIM**=DUPIP1*TI+DUPIM1*T(IM1)                                  G0012200
                C          CPVIM**=YSIM**CPVMA(IM1)+YOIM**CPVOL(IM1)+YVIM**CPVOS(IM1)     G0012210
                C             WAS DELETED.                                                G0012220
ISN      713               CPVIM**=DUPIM1*CGP(IM1)+(ONE-DUPIM1)*CGP(I)                    G0012230
ISN      714               OEMINP(I) = WIDTH*PHI(I) * (                                   G0012240
                C     1                 SMP(I)*DMP(I)* CMP(I)*T(I)                        G0012250
                C     2               + SOP(I)*DOP(I)* COP(I)*T(I)                        G0012260
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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
                      3              + SGP(I)*DGP(I)*(CGP(I)*T(I)+LAMBDA(I)))                          G0012270
                      4              + WIDTH*(ONE-PHI(I))*DBCB(I)*T(I)                                 G0012280
ISN      715          OENFLX(I) = -OPDX1 * (                                                           G0012290
                      1              TAUMP2* CMP(IM1)*TIMH                                             G0012300
                      2            + TAUOP2* COP(IM1)*TIMH                                             G0012310
                      3            + TAUGP2*(CPVI**TIMH+HVIM1))                                        G0012320
                      4            + KC(I)*(T(IM1-T(I))/DX(IM1)                                        G0012330
ISN      716          OMATIP(I)=WIDTH*PHI(I)*SMP(I)*DMP(I)                                             G0012340
ISN      717          OOIL P(I)=WIDTH*PHI(I)*SOP(I)*DOP(I)                                             G0012350
ISN      718          OGAS P(I)=WIDTH*PHI(I)*SGP(I)*DGP(I)                                             G0012360
ISN      719     404  CONTINUE                                                                         G0012370
ISN      720     405  CONTINUE                                                                         G0012380
                C                                                                                     G0012390
                C*****************************************************************************      G0012400
                C          I HOPE THAT THESE STATEMENTS ARE IN THE RIGHT PLACE.                       G0012410
ISN      721          SMPDUM=0.5D0*(SMP(1)+SMP(2))                                                     G0012420
ISN      722          SGPDUM=0.5D0*(SGP(1)+SGP(2))                                                     G0012430
ISN      723          ICTN=1                                                                           G0012440
ISN      724          IDUM=0                                                                           G0012450
ISN      725          CALL PERMS(1,.FALSE.)                                                            G0012460
ISN      726          IF (IERR.NE.0) GO TO 2618                                                        G0012470
ISN      727          KRMP15=KRMDUM                                                                    G0012480
ISN      728          KRGP15=KRGDUM                                                                    G0012490
ISN      729          KROP15=KRODUM                                                                    G0012500
                C*****************************************************************************      G0012510
ISN      730          DPDX15=(P(2)-P(1))/DX(1)                                                         G0012520
ISN      731          IUP=1                                                                            G0012530
ISN      732          IF (P(2).GT.P(1)) IUP=2                                                          G0012540
ISN      734          TAUM15=(DMP(1)+DMP(2))/(UMP(1)+UMP(2))*KA*KRMP(IUP)                              G0012550
ISN      735          TAUO15=(DOP(1)+DOP(2))/(UOP(1)+UOP(2))*KA*KROP(IUP)                              G0012560
ISN      736          IF (IVERSN.LT.8)                                                                 G0012570
                      1 TAUG15=(DGP(1)+DGP(2))/(UGP(1)+UGP(2))*KA*KRGP(IUP)                           G0012580
ISN      738          STAB1=2.D0*PHI(1)/DTEX                                                           G0012590
ISN      739          IUP2=3                                                                           G0012600
ISN      740          IF(P(2).GT.P(3))IUP2=2                                                           G0012610
ISN      742          DPDX1=PGRDNT                                                                     G0012620
ISN      743          DPDX25=(P(3)-P(2))/DX(2)                                                         G0012630
ISN      744          TAUM25=(DMP(2)+DMP(3))/(UMP(2)+UMP(3))*KA*KRMP(IUP2)                             G0012640
ISN      745          TAUO25=(DOP(2)+DOP(3))/(UOP(2)+UOP(3))*KA*KROP(IUP2)                             G0012650
ISN      746          IF (IVERSN.LT.8)                                                                 G0012660
                      1 TAUG25=(DGP(2)+DGP(3))/(UGP(2)+UGP(3))*KA*KRGP(IUP2)                          G0012670
ISN      748          IF (1.EQ.1) GO TO 42310                                                          G0012680
ISN      749          TAUMP1=DMP(1)*KA*KRMP15/UMP(1)                                                   G0012690
ISN      750          TAUOP1=DOP(1)*KA*KROP15/UOP(1)                                                   G0012700
ISN      751          IF (IVERSN.LT.8)                                                                 G0012710
                      1 TAUGP1=DGP(1)*KA*KRGP15/UGP(1)                                                G0012720
ISN      753          IF (IVERSN.GE.8) THEN                                                            G0012730
ISN      754             GPC15=BESRAT*( GAMMA1*DPDX1*(TAUMP1-GAMMA2*DPDX15*TAUM15                      G0012740
                      1                                          -GAMMA3*DPDX25*TAUM25 ) +            G0012750
                      2       HBESIN*STAB1*DMP(1)*SMP(1)                                              G0012760
ISN      755             GPC27=BESRAT*( GAMMA1*DPDX1*TAUOP1*XMOLE(1,1)                                 G0012770
                      1       -GAMMA2*DPDX15*TAUO15*XMOLE(1,2)+GAMMA3*DPDX25*TAUO25                   G0012780
                      2       *XMOLE(1,IUP2)) + HBESIN*STAB1*DOP(1)*SOP(1)*XMOLE(1,1)                 G0012790
ISN      756             GPC39=BESRAT*( GAMMA1*DPDX1*TAUOP1*XMOLE(2,1)                                 G0012800
                      1       -GAMMA2*DPDX15*TAUO15*XMOLE(2,2)+GAMMA3*DPDX25*                         G0012810
                      2       TAUO25*XMOLE(2,IUP2))                                                   G0012820
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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
                      3       + HBESIN*STAB1*DOP(1)*SOP(1)*XMOLE(2,1)                                 G0012830
ISN      757             GPC38=BESRAT*( GAMMA1*TAUOP1*XMOLE(3,1)*DPDX1-GAMMA2*TAUO15*G0012840
                      1       DPDX15* XMOLE(3,2)+GAMMA3*TAUO25*DPDX25*XMOLE(3,IUP2) )                 G0012850
                      2       + HBESIN*STAB1*DOP(1)*SOP(1)*XMOLE(3,1)                                 G0012860
ISN      758          ELSE                                                                             G0012870
ISN      759           GPC15=BESRAT*( GAMMA1*DPDX1*(TAUMP1+TAUGP1*YMOLE(4,1))-GAMMA2*                  G0012880
                     1 DPDX15*(TAUM15+TAUG15*YS1PT5)+GAMMA3*DPDX25*(TAUM25+TAUG25*                    G0012890
                     2 YS2PT5))+ HBESIN*STAB1*(DMP(1)*SMP(1)+DGP(1)*SGP(1)*YMOLE(4,1))               G0012900
ISN      760           GPC27=BESRAT*( GAMMA1*DPDX1*(TAUOP1*XMOLE(1,1)+TAUGP1*YMOLE(1,1))               G0012910
                     1 -GAMMA2*DPDX15*(TAUO15+TAUG15*KO1PT5)*XMOLE(1,2)+GAMMA3*DPDX25*                G0012920
                     2 (TAUO25+TAUG25*KO2PT5)*XMOLE(1,IUP2) ) + HBESIN*STAB1*(DOP(1)                  G0012930
                     3 *SOP(1)*XMOLE(1,1)+DGP(1)*SGP(1)*YMOLE(1,1))                                   G0012940
ISN      761           GPC39=BESRAT*( GAMMA1*DPDX1*(TAUOP1*XMOLE(2,1)+TAUGP1*YMOLE(2,1))               G0012950
                     1 -GAMMA2*DPDX15*(TAUO15+TAUG15*KS1PT5)*XMOLE(2,2)+GAMMA3*DPDX25*                G0012960
                     2 (TAUO25+TAUG25*KS2PT5)*XMOLE(2,IUP2) ) + HBESIN*STAB1*                         G0012970
                     3 (DOP(1)*SOP(1)*XMOLE(2,1)+DGP(1)*SGP(1)*YMOLE(2,1))                            G0012980
ISN      762             GPC38=BESRAT*( GAMMA1*TAUOP1*XMOLE(3,1)*DPDX1-GAMMA2*TAUO15*                 G0012990
                      1       DPDX15*XMOLE(3,2)+GAMMA3*TAUO25*DPDX25*XMOLE(3,IUP2) ) +                G0013000
                      2       HBESIN*STAB1*DOP(1)*SOP(1)*XMOLE(3,1)                                   G0013010
ISN      763          END IF                                                                           G0013020
ISN      764  42310  CONTINUE                                                                         G0013030
ISN      765          TAUMP1=DMP(1)*KA*KRMP(1)/UMP(1)                                                  G0013040
ISN      766          TAUOP1=DOP(1)*KA*KROP(1)/UOP(1)                                                  G0013050
ISN      767          TAUGP1=DGP(1)*KA*KRGP(1)/UGP(1)                                                  G0013060
ISN      768   453    TOTINJ=AINJV                                                                     G0013070
ISN      769          IF (IVERSN.GE.8) THEN                                                            G0013080
ISN      770             GIC18=HBESIN*STAB1*DMP(1)*SMP(1)                                              G0013090
C                     1    + BESRAT*(-GAMMA1*DMP(1)*MATINJ*TOTINJ HAS DELETED.                        G0013100
CC                    2       -GAMMA2*DPDX15*TAUM15+GAMMA3*TAUM25*DPDX25 ) HAS DELETED.               G0013110
ISN      771             GIC24=HBESIN*STAB1*DOP(1)*SOP(1)*XMOLE(1,1)                                   G0013120
C                     1    + BESRAT*(-GAMMA1*DOP(1)*HCINJ*XOINJ*TOTINJ HAS DELETED.                   G0013130
CCCC                  2       -GAMMA2*DPDX15*TAUO15*XO(1)                                             G0013140
CCCC                  3       +GAMMA3*DPDX25*TAUO25*XO(IUP2) )                                        G0013150
C                        HAS ALL DELETED.                                                             G0013160
ISN      772             GIC38=HBESIN*STAB1*DOP(1)*SOP(1)*XMOLE(2,1)                                   G0013170
CCCC                  1    + BESRAT*(-GAMMA1*DOP(1)*HCINJ*XSINJ*TOTINJ HAS DELETED.                   G0013180
CCCC                  2       -GAMMA2*DPDX15*TAUO15*XSOL(1)                                           G0013190
CCCC                  3       +GAMMA3*DPDX25*TAUO25*XSOL(IUP2) )                                      G0013200
C                        HAS ALL DELETED.                                                             G0013210
ISN      773             GIC43=HBESIN*STAB1*DOP(1)*SOP(1)*XMOLE(3,1)                                   G0013220
CCCC                  1    + BESRAT*( GAMMA1*DOP(1)*HCINJ*XNINJ*TOTINJ HAS DELETED.                   G0013230
CCCC                  2       - GAMMA2*TAUO15*DPDX15*XN(1)                                            G0013240
CCCC                  3       + GAMMA3*DPDX25*TAUO25*XN(IUP2) )                                       G0013250
C                        HAS ALL DELETED.                                                             G0013260
ISN      774          ELSE                                                                             G0013270
ISN      775          GIC18=HBESIN*STAB1*(DMP(1)*SMP(1)+DGP(1)*SGP(1)*YMOLE(4,1))                      G0013280
CCCC                  1    + BESRAT*(-GAMMA1*(DMP(1)*MATINJ+DGP(1)*GASINJ*YSINJ)*TOTINJ                G0013290
CCCC                  2    -GAMMA2*DPDX15*(TAUM15+TAUG15*YS1PT5)+GAMMA3*(TAUM25+TAUG25*                G0013300
CCCC                  3    YS2PT5)*DPDX25 ) HAS ALL DELETED.                                           G0013310
ISN      776           GIC34=HBESIN*STAB1*(DOP(1)*SOP(1)*XMOLE(1,1)+                                 G0013320
                      1       DGP(1)*SGP(1)*YMOLE(1,1))                                               G0013330
CCCC                  2 +BESRAT*(-GAMMA1*(DOP(1)*HCINJ*XOINJ+DGP(1)*GASINJ*YOINJ)*TOTINJ-G0013340
CCCC                  3 GAMMA2*DPDX15*(TAUO15+TAUG15*KO1PT5)*XO(1)+GAMMA3*DPDX25*(TAUO25+G0013350
CCCC                  4 TAUG25*KO2PT5)*XO(IUP2) )  HAS ALL DELETED.                                   G0013360
ISN      777           GIC38=HBESIN*STAB1*(DOP(1)*SOP(1)*XMOLE(2,1)+                                 G0013370
                      1       DGP(1)*SGP(1)*YMOLE(2,1))                                               G0013380
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                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
                     2 + RESRAT*(-GAMMA1*(DOP(I)*HCINJ#*XSINJ+OGP(I)*GASINJ#*YYINJ)*      G0013390
                     3 TOTINJ-GAMMA2*DPDX15*(TAUO15+TAUG15*KS1PT5)*XSOL(I)+GAMMA3*DPDX25G0013400
                     4 *(TAUO25+TAUG25*KS2PT5)*XSOL(IUP2) )   HAS ALL DELETED.        G0013410
ISN      778         GIC43=HBESI#*STAR1*DOP(I)*SOP(I)*XMOLE(3,I)                       G0013420
                    1   + RESRAT*( GAMMA1*(DOP(I)*HCINJ#*XNINJ#TOTINJ HAS DELETED.     G0013430
                    2   - GAMMA2*TAUO15*DPDX15*XN(I) + GAMMA3*DPDX25*TAUO25*XN(IUP2) )G0013440
                          HAS ALL DELETED.                                            G0013450
ISN      779           END IF                                                         G0013460
ISN      780         IF (OUT) QENFLX(1) = (AINJV/MOBTL) *  (                          G0013470
                    1                     MOBML*DMP(1)* CMP(1)*T(1)                 G0013480
                    2                   + MOBOL*DOP(1)* COP(1)*T(1)                 G0013490
                    3                   + MOBGL*DGP(1)*(CGP(1)*T(1)+LAMBDA(1)))     G0013500
ISN      782         IF (.NOT.OUT) QENFLX(1) = TOTINJ *  (                            G0013510
                    1                     MATINJ(1)*DMP(1)* CMP(1)*T(1)             G0013520
                    2                   + MOBINJ(1)*DOP(1)* COP(1)*T(1)             G0013530
                    3                   + VAPINJ(1)*DGP(1)*(CGP(1)*T(1)+LAMBDA(1))) G0013540
ISN      784         QENFLX(NG+1) = (PRODV/MOBTR) *  (                                G0013550
                    1                  MOBMR*DMP(NG)* CMP(NG)*T(NG)                 G0013560
                    2                + MOBOR*DOP(NG)* COP(NG)*T(NG)                 G0013570
                    3                + MOBGR*DGP(NG)*(CGP(NG)*T(NG)+LAMBDA(NG)))    G0013580
                    4                + KC(NJAY)*(T(NG)-T(NJAY))/DX(NG)              G0013590
                                                                                     G0013600
ISN      785         END IF                                                          G0013610
                                                                                     G0013620
                     THIS CHANGE (1986/06/30), EVEN MORE THAN THE CHANGE AT 368.98,  G0013630
                     WHICH IT SUPERSEDED, WILL SURELY AFFECT SLIGHTLY THE NUMBERS    G0013640
                     WHICH THE 1-D SIMULATOR CALCULATES.  ANY SUCH CHANGE WILL       G0013650
                     ALMOST CERTAINLY BE AN IMPROVEMENT.                             G0013660
ISN      786       IF ((EQCHEK.AND.(CHANGE.OR.OVTAKE)).OR.BACKUP.OR.CLOSE) THEN      G0013670
ISN      787         WRITE(6,621)                                                    G0013680
ISN      788  621    FORMAT(' ***+++ THE DTRATI SECTION WILL BE BYPASSED.')          G0013690
ISN      789         GO TO 1996                                                      G0013700
ISN      790       END IF                                                            G0013710
                                                                                     G0013720
                   4.6  UPDATE OLD VALUES, EXTRAPOLATE NEW VALUES.                  G0013730
                                                                                     G0013740
                     STORDT=DT WAS MOVED.                                            G0013750
                     IF (BIG.GT.BIGMAX.OR.DDX.GT.DDXMAX) DT=DT*SMALLR WAS DELETED.   G0013760
                     IF ((BIG.LT.BIGMIN.AND.DDX.LT.DDXMIN) WAS DELETED.              G0013770
                    1   .AND..NOT.EQCHEK.AND.ITERAT.LT.MAX0(6,IENDNL/2)) WAS DELETED. G0013780
                    2 DT=DT*BIGGER WAS DELETED.                                      G0013790
                     IF(DT.GT.DTMAX)DT=DTMAX WAS DELETED.                            G0013800
                       NOW IT IS SAFE TO SET DT TO ITS NEW VALUE.                    G0013810
ISN      791       DT=DTEX                                                         G0013820
                     ICHECK=6 WAS MOVED.                                             G0013830
                     WRITE(6,4710)DTEX,DT,STORDT,ODT,ICHECK WAS MOVED.               G0013840
                         ODT IS FOR CALCULATING DTRATI.  WAS MOVED.                  G0013850
                       STORDT IS FOR BEING PRINTED BY OUTPT1.  WAS MOVED.            G0013860
                     IF (DTEX.NE.DT) GO TO 224 WAS MOVED.                            G0013870
ISN      792         IF (CHANGE) IJKLMN=0                                          G0013880
                     IF (BACKUP) GO TO 700 WAS DELETED.                              G0013890
                                                                                     G0013900
                     DTRATI=DT/ODT  IS TEMPORARILY  (1988/01/14)  REPLACED BY        G0013910
ISN      794         DTRATI=1.00-4                                                   G0013920
ISN      795         IF (ITIME.EQ.2.AND..NOT.RESTRT) DTRATI=1.00-4                   G0013930
ISN      797         DTRATP=DTRATI                                                   G0013940
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                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
ISN      798         IF (IJKLMN.LE.IFIRST.AND..NOT.EQCHEK) DTRATP=1.00-4             G0013950
ISN      800         IF (CHANGE.OR.OVTAKE.OR.IJKLMN.LE.2) DTRATP=1.00-4              G0013960
ISN      802         IF (CHANGE.OR.OVTAKE)                DTRATI=1.00-4              G0013970
                       DTRATI WAS SET TO A NUMBER LARGER THAN ZERO SO THAT           G0013980
                       FRDSM(I) IS ALMOST NEVER EQUAL TO 0/0 .                       G0013990
ISN      804       DO 408 I=1,NGRPS                                                G0014000
                                                                                     G0014010
ISN      805         ODGP(I)=DGP(I)                                                  G0014020
ISN      806         ODMP(I)=DMP(I)                                                  G0014030
ISN      807         ODOP(I)=DOP(I)                                                  G0014040
ISN      808         OPHI(I)=PHI(I)                                                  G0014050
ISN      809         OEQUIL(I)=EQUIL(I)                                              G0014060
ISN      810         OYMOLE(4,I)=YMOLE(4,I)                                          G0014070
ISN      811         OYMOLE(1,I)=YMOLE(1,I)                                          G0014080
ISN      812         OYMOLE(2,I)=YMOLE(2,I)                                          G0014090
ISN      813         OIENTT(I)=IENTTL(I)                                             G0014100
ISN      814         OIENXN(I)=IENTXN(I)                                             G0014110
ISN      815         OIENSH(I)=IENTSH(I)                                             G0014120
ISN      816         OIEWSL(I)=IENTSL(I)                                             G0014130
                                                                                     G0014140
                       A DIFFERENT DT RATIO IS USED FOR PRESSURE, BECAUSE NO         G0014150
                       ACCUMULATION TERMS ARE PROPORTIONAL TO PRESSURE, AND BECAUSE   G0014160
                       THE PRESSURE GRADIENT SOMETIMES REVERSES.                     G0014170
                                                                                     G0014180
                       THIS ARRANGEMENT OF THE EQUATIONS PREVENTS ROUND-OFF DRIFT     G0014190
                       WHEN THE NEW VALUES AND OLD VALUES OF THE STATE VARIABLES      G0014200
                       ARE THE SAME.                                                 G0014210
                                                                                     G0014220
ISN      817           PGUES =      P(I)   + DTRATP * (      P(I)   -      OP(I)  ) G0014230
ISN      818           TGUES =      T(I)   + DTRATI * (      T(I)   -      OT(I)  ) G0014240
ISN      819         SMGUES =    SMP(I)   + DTRATI * (    SMP(I)   -    OSMP(I)  ) G0014250
ISN      820         SOGUES =    SOP(I)   + DTRATI * (    SOP(I)   -    OSOP(I)  ) G0014260
ISN      821         SGGUES =    SGP(I)   + DTRATI * (    SGP(I)   -    OSGP(I)  ) G0014270
ISN      822         X1GUES = XMOLE(1,I)  + DTRATI * ( XMOLE(1,I)  - OXMOLE(1,I)  ) G0014280
ISN      823         X2GUES = XMOLE(2,I)  + DTRATI * ( XMOLE(2,I)  - OXMOLE(2,I)  ) G0014290
ISN      824         X3GUES = XMOLE(3,I)  + DTRATI * ( XMOLE(3,I)  - OXMOLE(3,I)  ) G0014300
ISN      825           RGUES =      R(I)   + DTRATI * (      R(I)   -      OR(I)  ) G0014310
ISN      826           DGUES =      D(I)   + DTRATI * (      D(I)   -      OD(I)  ) G0014320
ISN      827           VGUES =      V(I)   + DTRATI * (      V(I)   -      OV(I)  ) G0014330
                                                                                     G0014340
ISN      828             OT(I)   =     T(I)                                         G0014350
ISN      829             OP(I)   =     P(I)                                         G0014360
ISN      830           OSMP(I)   =   SMP(I)                                         G0014370
ISN      831           OSOP(I)   =   SOP(I)                                         G0014380
ISN      832           OSGP(I)   =   SGP(I)                                         G0014390
ISN      833         OXMOLE(1,I) = XMOLE(1,I)                                       G0014400
ISN      834         OXMOLE(2,I) = XMOLE(2,I)                                       G0014410
ISN      835         OXMOLE(3,I) = XMOLE(3,I)                                       G0014420
ISN      836             OR(I)   =     R(I)                                         G0014430
ISN      837             OD(I)   =     D(I)                                         G0014440
ISN      838             OV(I)   =     V(I)                                         G0014450
                                                                                     G0014460
ISN      839             T(I)    =   TGUES                                        G0014470
ISN      840             P(I)    =   PGUES                                        G0014480
ISN      841           SMP(I)    =  SMGUES                                        G0014490
ISN      842           SOP(I)    =  SOGUES                                        G0014500
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                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
ISN      843              SGP(I)   =   SGGUES                                  G0014510
ISN      844            XMOLE(1,I) =   XIGUES                                  G0014520
ISN      845            XMOLE(2,I) =   X2GUES                                  G0014530
ISN      846            XMOLE(3,I) =   X3GUES                                  G0014540
ISN      847                R(I)   =    RGUES                                  G0014550
ISN      848                D(I)   =    DGUES                                  G0014560
ISN      849                V(I)   =    VGUES                                  G0014570
C                                                                               G0014580
ISN      850            IF (LFRNT(I).AND.SMP(I).LT.SNC) THEN                   G0014590
ISN      851               SMP(I)=SNC                                          G0014600
ISN      852               SOP(I)=ONE-SMP(I)-SGP(I)                            G0014610
C                     JUST IN CASE I DECIDE TO ALLOW SGP(FRONT) TO BE NON-ZERO. G0014620
ISN      853             END IF                                                G0014630
C                       THIS IS A SEMI-PERMANENT (1986/03/14) FIX.            G0014640
C                       ALSO SEE THE SEMI-PERM. FIX AT ALAJST, LINES 830.2/830.95 . G0014650
C                                                                             G0014660
C                       IN CASE OF RESTART, PROPTY WOULD HAVE BEEN CALLED     G0014670
C                       AT THE START OF THE TIME STEP LOOP.                   G0014680
ISN      854            SMPNK(I)=OSMP(I)                                      G0014690
ISN      855            SOPNK(I)=OSOP(I)                                      G0014700
ISN      856          408 CONTINUE                                            G0014710
C                                                                             G0014720
C               BEFORE 1987/07/22, A CALL TO PROPTY WAS LOCATED HERE.         G0014730
C               HOWEVER, THE TEST FOR IERR.NE.0 TURNED OUT TO BE PREMATURE.   G0014740
C               THEREFORE, THE CALL TO PROPTY AND THE TEST FOR IERR.NE.0 HAVE G0014750
C               BEEN MOVED TO SHORTLY AFTER THE WRITE STATEMENTS IN 439/440.  G0014760
ISN      857            IF (NDIMNS.LE.1) THEN                                 G0014770
ISN      858               DO 409 ICOMPO=1,9                                  G0014780
ISN      859                  OFLINJ(ICOMPO)=FLINJ(ICOMPO)                    G0014790
ISN      860                  OFLPRD(ICOMPO)=FLPRD(ICOMPO)                    G0014800
ISN      861        409       CONTINUE                                        G0014810
ISN      862               OFLINJ(11)=FLINJ(11)                               G0014820
C                                                                             G0014830
ISN      863               AIGUES =    AINJV   + DTRATP * (    AINJV   -    OAINJV   )  G0014840
ISN      864               PRGUES =    PRODV   + DTRATP * (    PRODV   -    OPRODV   )  G0014850
ISN      865               OAINJV  =  AINJV                                    G0014860
ISN      866               OPRODV  =  PRODV                                    G0014870
ISN      867               IF (ITIME.GT.2) AINJV  =   AIGUES                   G0014880
ISN      869               IF (ITIME.GT.2) PRODV  =   PRGUES                   G0014890
ISN      871             END IF                                                G0014900
C                                                                             G0014910
C              OMOBGL  =  MOBGL WAS DELETED.                                  G0014920
C              OMOBHL  =  MOBHL WAS DELETED.                                  G0014930
C              OMOBOL  =  MOBOL WAS DELETED.                                  G0014940
C              OMOBTL  =  MOBTL WAS DELETED.                                  G0014950
C              OMOBGR  =  MOBGR WAS DELETED.                                  G0014960
C              OMOBHR  =  MOBHR WAS DELETED.                                  G0014970
C              OMOBOR  =  MOBOR WAS DELETED.                                  G0014980
C              OMOBTR  =  MOBTR WAS DELETED.                                  G0014990
C                                                                             G0015000
ISN      872            IF (TRACKF) THEN                                      G0015010
ISN      873               IF (NDIMNS.LE.1) THEN                              G0015020
ISN      874                  XXGUES=OISTX(MFRONT)+DTRATI*(DISTX(MFRONT)-OOISTX(MFRONT)) G0015030
ISN      875                  OOISTX(MFRONT)=DISTX(MFRONT)                    G0015040
ISN      876                  DISTX(MFRONT)=XXGUES                            G0015050
                                                                              G0015060
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                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
ISN      877                  OOISTX(MFRONT-1)=OISTX(MFRONT-1)                 G0015070
C                       THIS IS JUST IN CASE THE FRONT HAS PASSED A GRID POINT. G0015080
ISN      878               DX(MFRONT-1)=DISTX(MFRONT)-DISTX(MFRONT-1)          G0015090
ISN      879               DX(MFRONT)  =DISTX(MFRONT+1)-DISTX(MFRONT)          G0015100
ISN      880               ODISXN=OOISTX(MFRONT)                               G0015110
ISN      881               OVTAKE=TRACKF.AND.                                  G0015120
                1             ((DISTX(MFRONT).GT.DISTX(MFRONT+1)).OR.           G0015130
                2              (DISTX(MFRONT-1).GT.OOISTX(MFRONT-1)))           G0015140
ISN      882               END IF                                              G0015150
ISN      883            IF (NDIMNS.GE.2) THEN                                  G0015160
ISN      884               DO 414 JGRPJ=1,NGRPS                                G0015170
ISN      885                  DO 412 ICOMPO=1,NCOMPS                           G0015180
ISN      886                     OCONCL(ICOMPO,JGRPJ)=CONCL(ICOMPO,JGRPJ)      G0015190
ISN      887                     OCONCV(ICOMPO,JGRPJ)=CONCV(ICOMPO,JGRPJ)      G0015200
ISN      888        412          CONTINUE                                      G0015210
ISN      889        414          CONTINUE                                      G0015220
ISN      890               DO 424 JB=1,NBNDBS                                  G0015230
ISN      891                 BVGUES = BVFLOW(JB)  + DTRATP*(BVFLOW(JB) -OBVFLO(JB) )  G0015240
ISN      892                 OBVFLO(JB) = BVFLOW(JB)                           G0015250
ISN      893                 BVFLOW(JB) = BVGUES                               G0015260
ISN      894        424      CONTINUE                                          G0015270
ISN      895               END IF                                              G0015280
ISN      896            END IF                                                 G0015290
ISN      897         IF (COORTR) THEN                                          G0015300
ISN      898            DO 430 JO=1,NOS                                        G0015310
ISN      899               FRGUES = FRNDIS(JO) + DTRATI*(FRNDIS(JO)-OFRNDS(JO))  G0015320
ISN      900               OFRNDS(JO) = FRNDIS(JO)                             G0015330
ISN      901               FRNDIS(JO) = FRGUES                                 G0015340
ISN      902        430    CONTINUE                                            G0015350
ISN      903            IF (ITIME.EQ.1) THEN                                   G0015360
ISN      904               DO 431 JO=1,NOS                                     G0015370
ISN      905                  FRNDIS(JO)=(ONE+VFFCTR*DT)*OFRNDS(JO)            G0015380
C                           SO THAT VFDOTN IS NOT INITIALLY ZERO.             G0015390
ISN      906        431      CONTINUE                                          G0015400
ISN      907               END IF                                              G0015410
ISN      908            END IF                                                 G0015420
C                                                                             G0015430
C              700 CONTINUE WAS DELETED.                                      G0015440
C                                                                             G0015450
C                5.  OUTPUT OF STEP N-1 VALUES (OPTIONAL)                     G0015460
C                    & AUTOMATIC TIME STEP CONTROL.                           G0015470
C                                                                             G0015480
C               IJKLMN PARTIALLY CONTROLS WHEN OUTPUT OCCURS.                 G0015490
C               OUTPUT OCCURS WHEN IJKLMN.LE.IFIRST.OR.IJKLMN.EQ.IMAXM,       G0015500
C                  WHERE IMAXM=IFIRST+ITNTVL.                                 G0015510
C               IJKLMN IS INITIALLY SET TO 0.  IS NORMALLY INCREMENTED BY 1,  G0015520
C                  IS SET BACK TO IFIRST WHEN IT REACHES IMAXM,                G0015530
C                  AND IS KEPT AT 0 WHEN AN EQUILIBRIUM CHANGE IS IMMINENT    G0015540
C                  (I.E. WHEN EQCHEK IS TRUE), AND IS ALLOWED TO INCREASE ONLY G0015550
C                  WHEN THIS CHANGE HAS OCCURRED.                             G0015560
C                                                                             G0015570
ISN      909            IF(EQCHEK) IJKLMN=0                                    G0015580
C              IF (SMIT1.AND..NOT.EQUIL(2)) GO TO 1720 WAS DELETED.           G0015590
ISN      911            IF(IJKLMN.LE.IFIRST.OR.IJKLMN.EQ.IMAXM)CALL OUTPT1(.FALSE.)  G0015600
ISN      913            IF (CHANGE.OR.OVTAKE) CALL OUTPT1(.FALSE.)             G0015610
ISN      915            IF (IJKLMN.EQ.IMAXM) IJKLMN=IFIRST                     G0015620
```

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                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
ISN      917          IJKLMN=IJKLMN+1                                                    G0015630
ISN      918          IF(TIME.GT.TIMMAX.OR.ITIME.GT.MAXSTP)GO TO 1192                    G0015640
                C                      ****************************************         G0015650
                C                      *****  BEGINNING OF OUTER ITERATION  *****         G0015660
                C                      ****************************************         G0015670
                C  WHICH STATEMENT SHOULD HAVE THE STATEMENT NUMBER 1996 ?                G0015680
ISN      919   1996   IEND=IENDNL                                                        G0015690
ISN      920          ICHECK=6                                                           G0015700
ISN      921          WRITE(6,47101)DTEX,DT,STORDT,DOT,ICHECK                            G0015710
                C            DOT IS FOR CALCULATING DTRATI.                             G0015720
                C         STORDT IS FOR BEING PRINTED BY OUTPT1.                        G0015730
ISN      922          IF (DTEX.NE.DT) GO TO 224                                          G0015740
ISN      923          ISTEPS=ITIME-1                                                     G0015750
                C         CONVERT TO COLD-WATER-EQUIVALENT (CWE) INJECTION RATE.        G0015760
ISN      924          IF (NDIMNS.LE.1)                                                   G0015770
                    1 QINCWE=QAINJV*((VAPINJ(1)*QDGP(1)+WATINJ(1)*QDWP(1))/            G0015780
                    2  (55.500*1.0098D0)                                               G0015790
ISN      926    1721 FORMAT(' ')                                                        G0015800
ISN      927    1722 FORMAT(' KEY',I5,I3,F12.1,2D14.6,F8.3,F13.4,4X,3G15.6)             G0015810
ISN      928          WRITE(6,1721)                                                      G0015820
ISN      929          WRITE(6,1722)ISTEPS,ITERAT,TIME,QAINJV,CUMPVI,QDISXN,              G0015830
                    1                    STORDT,BALERR(4),BALERR(5),BALERR(1)          G0015840
ISN      930          WRITE(9,1722)ISTEPS,ITERAT,TIME,QAINJV,CUMPVT,QDISXN,              G0015850
                    1                    STORDT,BALERR(4),BALERR(5),BALERR(1)          G0015860
ISN      931          IF (CHANGE.OR.OVTAKE) THEN                                         G0015870
ISN      932             WRITE(6,1722)ISTEPS,ITERAT,TIME,QAINJV,CUMPVI,QDISXN,STORDT    G0015880
ISN      933             WRITE(9,1722)ISTEPS,ITERAT,TIME,QAINJV,CUMPVI,QDISXN,STORDT    G0015890
ISN      934          END IF                                                             G0015900
ISN      935    1724 FORMAT(' RUNNING TOTALS FOR ITERATION COUNTS: ',3I6)                G0015910
ISN      936          WRITE(6,1724)NITRS1,NITRS2,NITRS3                                  G0015920
                C         MODIFIED EXTRAPOLATION FORMULAE: WERE ALL DELETED.            G0015930
                C      KRMEX=KRMP(1) WAS DELETED.                                       G0015940
                C      KRGEX=KRGP(1) WAS DELETED.                                       G0015950
                C      KROEX=KROP(1) WAS DELETED.                                       G0015960
                C      P2EX=P(2) WAS DELETED.                                           G0015970
ISN      937          TIME=TIME+DT                                                       G0015980
ISN      938          STORDT=DT                                                          G0015990
ISN      939          IF (NDIMNS.LE.1) THEN                                              G0016000
ISN      940             DISXN=DISTX(NFRONT)                                             G0016010
ISN      941             CLOSE=(DABS(DISTX(NFRONT+1)-DISXN)).LT.(1.0D-1*(DISXN-ODISXN)) G0016020
ISN      942             IF (CLOSE.OR.(OVTAKE.AND..NOT.EQCHEK)) GO TO 2619               G0016030
ISN      943          END IF                                                             G0016040
ISN      944          ITERAT=0                                                           G0016050
ISN      945          REPEPT=.FALSE.                                                     G0016060
ISN      946          REPESC=.FALSE.                                                     G0016070
                C         IF THE EXTRAPOLATION STEP RESULTS IN A DECISION TO RESTART    G0016080
                C         THE TIME STEP, THEN REPEPT AND REPESC MUST BE DEFINED.        G0016090
ISN      947          I1=1                                                               G0016100
ISN      948          I2=2                                                               G0016110
ISN      949          I3=3                                                               G0016120
ISN      950          IF (SMIT2.AND..NOT.SMIT6) WRITE(6,49111)I1,(P(IK),IK=1,6)          G0016130
ISN      952          IF (SMIT2) GO TO 48130                                             G0016140
ISN      953          WRITE (6,49109)ITERAT                                              G0016150
ISN      954          WRITE (6,49111)I1,(  P(IK),IK=01,06)                               G0016160
ISN      955          WRITE (6,49111)I2,(  P(IK),IK=07,12)                               G0016170
ISN      956          WRITE (6,49111)I3,(  P(IK),IK=13,17)                               G0016180
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                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
ISN      957          WRITE (6,49112)I1,(  T(IK),IK=01,06)                               G0016190
ISN      958          WRITE (6,49112)I2,(  T(IK),IK=07,12)                               G0016200
ISN      959          WRITE (6,49112)I3,(  T(IK),IK=13,17)                               G0016210
ISN      960          WRITE (6,49114)I1,(SGP(IK),IK=01,06)                               G0016220
ISN      961          WRITE (6,49114)I2,(SGP(IK),IK=07,12)                               G0016230
ISN      962          WRITE (6,49115)I1,(SOP(IK),IK=01,06)                               G0016240
ISN      963          WRITE (6,49115)I2,(SOP(IK),IK=07,12)                               G0016250
ISN      964          WRITE (6,49115)I3,(SOP(IK),IK=13,17)                               G0016260
ISN      965          WRITE (6,49116)I1,(SWP(IK),IK=01,06)                               G0016270
ISN      966          WRITE (6,49116)I2,(SWP(IK),IK=07,12)                               G0016280
ISN      967          WRITE (6,49116)I3,(SWP(IK),IK=13,17)                               G0016290
ISN      968          WRITE (6,49117)I1,(XMOLE(1,IK),IK=01,06)                           G0016300
ISN      969          WRITE (6,49117)I2,(XMOLE(1,IK),IK=07,12)                           G0016310
ISN      970          WRITE (6,49117)I3,(XMOLE(1,IK),IK=13,17)                           G0016320
ISN      971          WRITE (6,49118)I1,(FRDSN(IK),IK=01,06)                             G0016330
ISN      972          WRITE (6,49118)I2,(FRDSN(IK),IK=07,12)                             G0016340
ISN      973          WRITE (6,49119)I1,(BVFLOW(IK),IK=1,06)                             G0016350
ISN      974          WRITE (6,49119)I2,(BVFLOW(IK),IK=7,12)                             G0016360
ISN      975          IF (NDIMNS.LT.1) WRITE (6,49120) AINJV, PRODV, DISTX(NFRONT)       G0016370
ISN      977          IF (NFPTOT.GT.0.AND..NOT.COORTR) THEN                              G0016380
ISN      978             WRITE (6,49121)(FPDIST(IK),IK=1,NFPTOT)                         G0016390
ISN      979             WRITE (6,49122)(FPDISX(IK),IK=1,NFPTOT)                         G0016400
ISN      980             WRITE (6,49123)(FPDISY(IK),IK=1,NFPTOT)                         G0016410
ISN      981          END IF                                                             G0016420
ISN      982          IF (COORTR) WRITE (6,49124)(FRNDIS(IK),IK=1,NOS)                   G0016430
ISN      984   48130  CONTINUE                                                          G0016440
ISN      985          WRITE (6,49119)I1,(BVFLOW(IK),IK=1,06)                             G0016450
ISN      986          IOOPS=0                                                            G0016460
                C         IF (P(1).LT.P(3)) IOOPS=1 HAS DELETED.                        G0016470
ISN      987          IF(IOOPS.NE.0)GO TO 2609                                           G0016480
                C         THIS IS A TEMPORARY (1984/03/28) FIX.                         G0016490
ISN      988   1998   ITERAT=ITERAT+1                                                    G0016500
ISN      989          NITRS1=NITRS1+1                                                    G0016510
ISN      990          JCSMPT=JCXPPT.AND.(.NOT.(CHANGE.OR.OVTAKE))                        G0016520
                    1 .AND.(ITERAT.NE.1+5*(ITERAT/5))                                   G0016530
ISN      991          JCSMSC=JCXPSC.AND.(.NOT.(CHANGE.OR.OVTAKE))                        G0016540
                    1 .AND.(ITERAT.NE.1+5*(ITERAT/5))                                   G0016550
ISN      992          ITERPR=ITERAT.EQ.4                                                 G0016560
                C                                                                       G0016570
ISN      993          CALL PROPTY(1,NGRPS,9,0)                                           G0016580
                C            I.E. CALL SUBROUTINE PROPTY(ISTART,IFINIS,LCTNPH,IJOB)     G0016590
ISN      994          IF (IERR.NE.0) GO TO 2618                                          G0016600
                C                                                                       G0016610
ISN      995          IF (NDIMNS.LE.1) THEN                                              G0016620
                C                                                                       G0016630
                C                                                                       G0016640
                C     7.  SPECIFICATION OF BOUNDARY CONDITIONS AT POINT #NJAY,          G0016650
                C         (AND ALSO AT POINT #1).                                       G0016660
                C                                                                       G0016670
ISN      996             IF (VAPINJ(1).GT.(SGIRR+1.0D-10).OR.SGP(1).GT.(SGIRR+1.0D-10)) G0016680
                    1    CALL VPTEMP(1,.TRUE.,.TRUE.,.TRUE.,.FALSE.,                   G0016690
                    2                LCTN,NGRPMX,P,XMOLE,                               G0016700
                    3                PEQUIL,T,PHAT,POIL,PSOL,                           G0016710
                    4                DPHAT,DPOIL,DPSOL,IERR,INROWG)                     G0016720
                C            I.E. CALL VPTEMP(IPARM,NORMAL,TCHNGE,DERIVS,LHALF,         G0016730
                C                             LCTN,NGRPMX,P,XMOLE,                      G0016740
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                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
                C                              PEQUIL,T,PMAT,POIL,PSOL,                                 G0016750
                C                              DPMAT,DPOIL,DPSOL,IERR,1HRONG)                           G0016760
                C                                                                                       G0016770
ISN      998           IF (1.EQ.1) GO TO 1730                                                           G0016780
ISN      999           T(NJAY)=((DX(NG)+DX(NG-1))**2*T(NG)-DX(NG)**2*T(NG-1))/                          G0016790
                     1  ((DX(NG)+DX(NG-1))**2-DX(NG)**2)                                               G0016800
                C          SET T(NJAY) SO THAT THE  CENTRED 2ND DERIVATIVE AT I=NG                     G0016810
                C             IS THE SAME AS THE UPSTREAM 2ND DERIVATIVE AT I=NG.                       G0016820
                C          SEE DERIVATION IN NOV.16,1981 NOTES.                                         G0016830
ISN     1000    1730  CONTINUE                                                                          G0016840
ISN     1001          ICNT=1                                                                            G0016850
                C          LINES 452.50/452.99 ARE RESERVED FOR CHECKING THE JACOBIAN.                  G0016860
ISN     1002          XOMX1=DX(NG)                                                                      G0016870
ISN     1003          X1MX2=DX(NG-1)                                                                    G0016880
ISN     1004          X2MX3=DX(NG-2)                                                                    G0016890
ISN     1005          XOMX2=DX(NG-1)+DX(NG)                                                             G0016900
ISN     1006          X1MX3=DX(NG-2)+DX(NG-1)                                                           G0016910
ISN     1007          XOMX3=DX(NG-2)+DX(NG-1)+DX(NG)                                                    G0016920
ISN     1008          T(NJAY) = T(NJAY-3)*(XOMX1*XOMX2)/(X2MX3*X1MX3)                                   G0016930
                     1        - T(NJAY-2)*(XOMX1*XOMX3)/(X1MX2*X2MX3)                                   G0016940
                     2        + T(NJAY-1)*(XOMX2*XOMX3)/(X1MX2*X1MX3)                                   G0016950
ISN     1009          T(NJAY)=T(NG) + (XOMX1/X1MX2)*(T(NG)-T(NG-1))                                     G0016960
                C          GOOD-BYE, FUDGED BOUNDARY CONDITIONS.                                        G0016970
ISN     1010          END IF                                                                            G0016980
                C                                                                                       G0016990
                C                                                                                       G0017000
ISN     1011          IF (NDIMNS.GE.2) THEN                                                             G0017010
                C                                                                                       G0017020
ISN     1012             DO 1740 J=1,NGRPS                                                              G0017030
ISN     1013             TO(J)=T(J)                                                                     G0017040
ISN     1014   1740      CONTINUE                                                                       G0017050
ISN     1015             TOHOLD=.TRUE.                                                                  G0017060
                C             THIS IS A TEMPORARY (1986/04/01) FIX.                                     G0017070
ISN     1016             SCALEV=1.0D6/DT                                                                G0017080
                C                                                                                       G0017090
ISN     1017             IF (COORTR) THEN                                                               G0017100
                C                                                                                       G0017110
ISN     1018                CALL SRCUPD(.TRUE.,.TRUE.,.TRUE.,1,NWELLS,                                  G0017120
                           1                NMELMX,NDIRMX,NGRPMX,                                       G0017130
                           2                LNEMNR,LMELL  ,JGNEAR,JMELOG,                               G0017140
                           3                IENTNO,IENTNR,JGPSC,                                        G0017150
                           4                ITABL,IERR)                                                 G0017160
                C                  I.E. CALL SRCUPD(ALWELS,LCNEAR,LCIENT,IWLSTA,IWLFIN,                 G0017170
                C                                   NMELMX,NDIRMX,NGRPMX,                               G0017180
                C                                   LNEMNR,LMELL  ,JGNEAR,JMELOG,                       G0017190
                C                                   IENTNO,IENTNR,JGPSC,                                G0017200
                C                                   ITABL,IERR)                                         G0017210
                C                                                                                       G0017220
ISN     1019             CALL LROUPD(NEDGMX,LROCK)                                                      G0017230
                C                I.E. CALL LROUPD(NEDGMX,LROCK)                                         G0017240
                C                                                                                       G0017250
ISN     1020             CALL CTEQNS(CONCL ,CONCV ,U1D   ,SCAREA,                                       G0017260
                           1                .TRUE.,NGRPMX,NFPTMX,NWELMX,NBNDMX,NBLKXX,                  G0017270
                           2                NDIRMX,NEDGMX,NCONMX,NUMAX ,NATRMX,NOMAX ,                  G0017280
                           3                NMCS  ,NCOMPS,NVARS ,NBALNS,                                G0017290
                                                                                                        G0017300
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                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
                           4                ACCUMO,FLTMXO,FLTMYO,FLTMTO,                                G0017310
                           5                ENMCFO,VOLCFO,FLORMO,ACUMFO,FLOMO ,                         G0017320
                           6                GVCXMO,GVCXVO,GVCYMO,GVCYVO,                                G0017330
                           7                DXCFLO,DYCFLO,SPLITO,SRCETO,                                G0017340
                           8                FF2D  ,COEFFS,LCONV ,REPEAT)                                G0017350
ISN     1021          END IF                                                                            G0017360
                C          I.E. CALL CTEQNS/ALEQNS(CONCL ,CONCV ,U1D   ,SCAREA,                         G0017370
                C                                  TEST  ,NGRPMX,NFPTMX,NWELMX,NBNDMX,NBLKXX,           G0017380
                C                                  NDIRMX,NEDGMX,NCONMX,NUMAX ,NATRMX,NOMAX ,           G0017390
                C                                  NMCS  ,NCOMPS,NVARS ,NBALNS,                         G0017400
                C                                  ACCUMO,FLTMXO,FLTMYO,FLTMTO,                         G0017410
                C                                  ENMCFO,VOLCFO,FLORMO,ACUMFO,FLOMO ,                  G0017420
                C                                  GVCXMO,GVCXVO,GVCYMO,GVCYVO,                         G0017430
                C                                  DXCFLO,DYCFLO,SPLITO,SRCETO,                         G0017440
                C                                  FF2DO ,COEFFS,LCONV ,REPEAT)                         G0017450
ISN     1022          TOHOLD=.FALSE.                                                                    G0017460
                C          ONLY IN THE MAIN PROGRAM ARE THERE STATEMENTS WHICH CAN                      G0017470
                C          CHANGE THE VALUE OF TOHOLD.                                                  G0017480
ISN     1023          IF (IERR.NE.0) GO TO 2618                                                         G0017490
ISN     1024          CALL ALSCAL(.FALSE.,NGRPMX,NCONMX,NVARS,                                          G0017500
                     1            DSCALE,FF2D,COEFFS)                                                  G0017510
                C          I.E. CALL SUBROUTINE ALSCAL(JCSM,NGRPMX,NCONMX,NVARS,                        G0017520
                C                                      DSCALE,FF2D,COEFFS)                              G0017530
ISN     1025          CALL ALSOLV(.FALSE.,LFULL,NCONMX,NUMAX,NGRPMX,NVARS,                              G0017540
                           1            COEFFS,FF2D,FFMCU,                                              G0017550
                           2            ML,MU,AJACBN,LDA,2,U1D,U,IPVT,ERYNCO)                           G0017560
                C          I.E. CALL ALSOLV(JCSM,LFULL,NCONMX,NUMAX,NGRPMX,NVARS,                       G0017570
                C                           COEFFS,FF2D,FFMCU,                                          G0017580
                C                           ML,MU,AJACBN,LDA,2,U1D,U,IPVT,ERYNCO)                       G0017590
ISN     1026          IF (ERYNCO.GT.0) GO TO 2620                                                       G0017600
ISN     1027          FDAMP=ONE                                                                         G0017610
ISN     1028          IF (ERRSCO.GT.0) FDAMP=0.9D0                                                      G0017620
ISN     1030          IF (ITIME.EQ.1.AND.ITERAT.EQ.1) FDAMP=1.0D-2                                      G0017630
ISN     1032          CALL ALAJST(.FALSE.,FDAMP,U1D,                                                    G0017640
                     1            .TRUE.,NGRPMX,NFPTMX,NWELMX,NBNDMX,NBLKXX,                          G0017650
                     2            NDIRMX,NEDGMX,NCONMX,NUMAX ,NATRMX,NOMAX ,                          G0017660
                     3            NMCS  ,NCOMPS,NVARS ,NBALNS,                                        G0017670
                     4            ACCUMO,FLTMXO,FLTMYO,FLTMTO,                                        G0017680
                     5            ENMCFO,VOLCFO,FLORMO,ACUMFO,FLOMO ,                                 G0017690
                     6            GVCXMO,GVCXVO,GVCYMO,GVCYVO,                                        G0017700
                     7            DXCFLO,DYCFLO,SPLITO,SRCETO,                                        G0017710
                     8            FF2D  ,COEFFS,LCONV ,REPEAT)                                        G0017720
                C          I.E. CALL ALAJST(JCCALC,FDAMP ,U1D,                                          G0017730
                C                           TEST  ,NGRPMX,NFPTMX,NWELMX,NBNDMX,NBLKXX,                  G0017740
                C                           NDIRMX,NEDGMX,NCONMX,NUMAX ,NATRMX,NOMAX ,                  G0017750
                C                           NMCS  ,NCOMPS,NVARS ,NBALNS,                                G0017760
                C                           ACCUMO,FLTMXO,FLTMYO,FLTMTO,                                G0017770
                C                           ENMCFO,VOLCFO,FLORMO,ACUMFO,FLOMO ,                         G0017780
                C                           GVCXMO,GVCXVO,GVCYMO,GVCYVO,                                G0017790
                C                           DXCFLO,DYCFLO,SPLITO,SRCETO,                                G0017800
                C                           FF2DO ,COEFFS,LCONV ,REPEAT)                                G0017810
ISN     1033          IF (IERR.NE.0) GO TO 2618                                                         G0017820
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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
                C                                                                                G0017870
                C          THIS IS A TEMPORARY (1986/03/24) FIX.                                 G0017880
ISN     1034            DO 452 JGRPJ=1,NGRPS                                                     G0017890
ISN     1035               IF (DABS(XMOLE(2,JGRPJ)).LT.1.0D-10) XMOLE(2,JGRPJ)=ZERO              G0017900
ISN     1037      452   CONTINUE                                                                 G0017910
                C                                                                                G0017920
ISN     1038            IF (.NOT.SWIT8) THEN                                                     G0017930
ISN     1039               SMP(4)=SMC                                                            G0017940
ISN     1040               SOP(4)=SOIRR                                                          G0017950
ISN     1041               SGP(4)=ONE-SMC-SOIRR                                                  G0017960
ISN     1042             END IF                                                                  G0017970
                C                                                                                G0017980
ISN     1043          END IF                                                                     G0017990
                C                                                                                G0018000
ISN     1044      454 ICNT=1                                                                     G0018010
                C                                                                                G0018020
ISN     1045          IF (NDIMNS.LE.1) THEN                                                      G0018030
                C                                                                                G0018040
                C                 ***************************************************            G0018050
                C                 ***** START OF PRESSURE-TEMPERATURE ITERATION *****            G0018060
                C                 ***************************************************            G0018070
                C                                                                                G0018080
                C                                                                                G0018090
                C     8.  CALCULATION OF CONDENSATION TERMS & ELEMENTS OF P-T MATRIX              G0018100
                C                                                                                G0018110
ISN     1046       71   CONTINUE                                                                 G0018120
                C                                                                                G0018130
                C          LINES 546.04/546.99 ARE RESERVED FOR CHECKING THE JACOBIAN.           G0018140
ISN     1047            DO 1750 I=1,NG                                                           G0018150
ISN     1048            DELSMP=SMP(I)-SMPNK(I)                                                   G0018160
ISN     1049            DELSOP=SOP(I)-SOPNK(I)                                                   G0018170
ISN     1050            SUM=DELSMP+DELSOP                                                        G0018180
ISN     1051            IF (DABS(SUM).GT.(0.1D0*DABS(DELSMP-DELSOP))) FRDSH(I)=DELSMP/SUM        G0018190
ISN     1053            IF (FRDSH(I).GT.+1.000) FRDSH(I)=+1.000                                  G0018200
ISN     1055            IF (FRDSH(I).LT. 0.000) FRDSH(I)= 0.000                                  G0018210
ISN     1057            SMPNK(I)=SMP(I)                                                          G0018220
ISN     1058            SOPNK(I)=SOP(I)                                                          G0018230
ISN     1059     1750   CONTINUE                                                                 G0018240
ISN     1060       73   CONTINUE                                                                 G0018250
ISN     1061            REPEPT=.FALSE.                                                           G0018260
ISN     1062            REPESC=.FALSE.                                                           G0018270
                C          IF THE PT STEP RESULTS IN A DECISION TO RESTART                       G0018280
                C          THE TIME STEP, THEN REPEPT AND REPESC MUST BE DEFINED.                G0018290
ISN     1063            JCTEST=.FALSE.                                                           G0018300
ISN     1064            JCSMPT=JCSMPT.AND..NOT.YOUCPT                                            G0018310
ISN     1065            YOUCPT=.FALSE.                                                           G0018320
ISN     1066            IF (OVTAKE) CALL WARN(1)                                                 G0018330
ISN     1068            FACTOR=1.000                                                             G0018340
ISN     1069            IF (((CHANGE.OR.OVTAKE).AND.EQCHEK).AND.ITERAT.LE.5) FACTOR=0.4D0        G0018350
                C                                                                                G0018360
ISN     1071            DO 1820 J=1,NGRPS                                                        G0018370
ISN     1072               TO(J)=T(J)                                                            G0018380
ISN     1073     1820   CONTINUE                                                                 G0018390
ISN     1074            TOHOLD=.TRUE.                                                            G0018400
                C                                                                                G0018410
                C                                                                                G0018420
```



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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
ISN     1075            TOHOLD=.FALSE.                                                           G0018430
                C          ONLY IN THE MAIN PROGRAM ARE THERE STATEMENTS WHICH CAN                G0018440
                C          CHANGE THE VALUE OF TOHOLD.                                           G0018450
ISN     1076            IF (IERR.NE.0) GO TO 2618                                                G0018460
                C                                                                                G0018470
ISN     1077            IF (IERR.NE.0) GO TO 2618                                                G0018480
                C                                                                                G0018490
                C                                                                                G0018500
ISN     1078            IF (IERR.NE.0) GO TO 2618                                                G0018510
ISN     1079            NITRS2=NITRS2+1                                                          G0018520
ISN     1080            IF (SWIT2.AND..NOT.SWIT6) WRITE(6,49111)I1,(P(IK),IK=1,6)                G0018530
ISN     1082            IF (SWIT2) GO TO 48180                                                   G0018540
ISN     1083            I1=1                                                                     G0018550
ISN     1084            I2=2                                                                     G0018560
ISN     1085            I3=3                                                                     G0018570
ISN     1086            WRITE (6,49110)     DT,TIME                                              G0018580
ISN     1087            WRITE (6,49109)ITERAT                                                    G0018590
ISN     1088            WRITE (6,49111)I1,  P(IK),IK=01,06)                                      G0018600
ISN     1089            WRITE (6,49111)I2,  P(IK),IK=07,12)                                      G0018610
ISN     1090            WRITE (6,49111)I3,  P(IK),IK=13,17)                                      G0018620
ISN     1091            WRITE (6,49112)I1,  T(IK),IK=01,06)                                      G0018630
ISN     1092            WRITE (6,49112)I2,  T(IK),IK=07,12)                                      G0018640
ISN     1093            WRITE (6,49112)I3,  T(IK),IK=13,17)                                      G0018650
ISN     1094            WRITE (6,49114)I1,SGP(IK),IK=01,06)                                      G0018660
ISN     1095            WRITE (6,49114)I2,SGP(IK),IK=07,12)                                      G0018670
ISN     1096            WRITE (6,49115)I1,SOP(IK),IK=01,06)                                      G0018680
ISN     1097            WRITE (6,49115)I2,SOP(IK),IK=07,12)                                      G0018690
ISN     1098            WRITE (6,49115)I3,SOP(IK),IK=13,17)                                      G0018700
ISN     1099            WRITE (6,49116)I1,SMP(IK),IK=01,06)                                      G0018710
ISN     1100            WRITE (6,49116)I2,SMP(IK),IK=07,12)                                      G0018720
ISN     1101            WRITE (6,49116)I3,SMP(IK),IK=13,17)                                      G0018730
ISN     1102            WRITE (6,49117)I1,XMOLE(1,IK),IK=01,06)                                  G0018740
ISN     1103            WRITE (6,49117)I2,XMOLE(1,IK),IK=07,12)                                  G0018750
ISN     1104            WRITE (6,49117)I3,XMOLE(1,IK),IK=13,17)                                  G0018760
ISN     1105            WRITE (6,49118)I1,FRDSW(IK),IK=01,06)                                    G0018770
ISN     1106            WRITE (6,49118)I2,FRDSW(IK),IK=07,12)                                    G0018780
ISN     1107            WRITE (6,49119)I1,BVFLOW(IK),IK=1,06)                                    G0018790
ISN     1108            WRITE (6,49119)I2,BVFLOW(IK),IK=7,12)                                    G0018800
ISN     1109            IF (NDIMNS.LT.1) WRITE (6,49120) AINJV, PRODV, DISTX(NFRONT)             G0018810
ISN     1111            IF (NFPTOT.GT.0.AND..NOT.COORTR) THEN                                    G0018820
ISN     1112               WRITE (6,49121)(FPDIST(IK),IK=1,NFPTOT)                               G0018830
ISN     1113               WRITE (6,49122)(FPDISW(IK),IK=1,NFPTOT)                               G0018840
ISN     1114               WRITE (6,49123)(FPDISV(IK),IK=1,NFPTOT)                               G0018850
ISN     1115             END IF                                                                  G0018860
ISN     1116            IF (COORTR) WRITE (6,49124)(FRNDIS(IK),IK=1,NOS)                         G0018870
ISN     1118     48180  CONTINUE                                                                 G0018880
ISN     1119            WRITE (6,49119)I1,(BVFLOW(IK),IK=1,06)                                   G0018890
ISN     1120            ICNT=ICNT+1                                                              G0018900
ISN     1121            IF(ICNT.GT.ITMAX)GO TO 214                                               G0018910
ISN     1122            REPEPT=REPEAT                                                            G0018920
                C          IF(REPEAT)GO TO 71 IS DELETED.                                        G0018930
                C                                                                                G0018940
                C                 ***************************************************            G0018950
                C                 ***** END OF PRESSURE-TEMPERATURE ITERATION *****              G0018960
                C                 ***************************************************            G0018970
                C                                                                                G0018980
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                 *....*...1.........2.........3.........4.........5.........6.........7.*.......8
ISN      1123   711    ITPT(ITERAT)=ICNT-1                                                      G0018990
ISN      1124          IF (.NOT.TRACKF) GO TO 715                                               G0019000
                C          DO THIS ONLY FOR THE FRONT-TRACKING CASE.                          G0019010
ISN      1125          OVTAKE=TRACKF.AND.                                                       G0019020
                      1 ((DISTX(MFRONT).GT.DISTX(MFRONT+1)).OR.                                G0019030
                      2  (DISTX(MFRONT-1).GT.ODISTX(MFRONT-1)))                               G0019040
ISN      1126           DISXM=DISTX(MFRONT)                                                     G0019050
ISN      1127           CLOSE=(DABS(DISTX(MFRONT+1)-DISXM)).LT.(1.D0-1*(DISXM-ODISXM))          G0019060
ISN      1128           IF (CLOSE.OR.(OVTAKE.AND..NOT.EOCHEK)) GO TO 2619                       G0019070
ISN      1129           IF (DISXM.LE.DISTX(MFRONT+1)) GO TO 714                                 G0019080
                C          IF SWITCH IS CALLED, REDO THE PT CALCULATION.                      G0019090
ISN      1130           GO TO 73                                                                G0019100
ISN      1131     714   CONTINUE                                                                G0019110
ISN      1132     715   CONTINUE                                                                G0019120
ISN      1133           IOOPS=0                                                                 G0019130
                C          IF (P(1).LT.P(3)) IOOPS=1 HAS DELETED. (1984/09/06)                 G0019140
ISN      1134           IF(IOOPS.NE.0)GO TO 2609                                                G0019150
ISN      1135           OUT=.FALSE.                                                             G0019160
ISN      1136           IF (P(NG).GT.P(1)) OUT=.TRUE.                                           G0019170
                CCC                                                                            G0019180
                CCC        ********************************************************            G0019190
                CCC        ***** START OF SATURATION-COMPOSITION ITERATION *****              G0019200
                CCC        ********************************************************            G0019210
ISN      1138   458    ICNT=1                                                                  G0019220
                C          PROPTY IS CALLED FROM WITHIN PTITER.                                G0019230
ISN      1139   210    CONTINUE                                                                G0019240
                C          LINES 910.58/911.99 ARE RESERVED FOR CHECKING THE JACOBIAN.         G0019250
ISN      1140           TOTINJ=AINJV                                                            G0019260
ISN      1141           ITM=ITIME                                                               G0019270
ISN      1142           ITR=ITERAT                                                              G0019280
ISN      1143           JCTEST=.FALSE.                                                          G0019290
ISN      1144           JCSMSC=JCSMSC.AND..NOT.VOUCSC                                           G0019300
ISN      1145           VOUCSC=.FALSE.                                                          G0019310
ISN      1146           IF (OVTAKE) CALL MARN(1)                                                G0019320
                C                                                                              G0019330
ISN      1148           DO 1830 J=1,NGRPS                                                       G0019340
ISN      1149              TO(J)=T(J)                                                           G0019350
ISN      1150    1830   CONTINUE                                                                G0019360
ISN      1151           TOHOLD=.TRUE.                                                           G0019370
                CC                                                                             G0019380
                                                                                               G0019390
ISN      1152           TOHOLD=.FALSE.                                                          G0019400
                CC            ONLY IN THE MAIN PROGRAM ARE THERE STATEMENTS WHICH CAN           G0019410
                CC            CHANGE THE VALUE OF TOHOLD.                                      G0019420
ISN      1153           IF (IERR.NE.0) GO TO 2618                                               G0019430
                C                                                                              G0019440
ISN      1154           IF (IERR.NE.0) GO TO 2618                                               G0019450
                CC                                                                             G0019460
                                                                                               G0019470
ISN      1155           IF (.NOT.TRACKF) GO TO 76245                                            G0019480
ISN      1156           SOIRRH=0.211D0                                                          G0019490
                C          THIS IS A TEMPORARY (1984/03/29) FIX.                               G0019500
ISN      1157           IF (SOP(MFRONT).GT.SOIRRH) GO TO 76243                                  G0019510
ISN      1158           SOP(MFRONT)=SOIRRH+4.0D-3                                               G0019520
ISN      1159           SWP(MFRONT)=ONE-SOP(MFRONT)-SGP(MFRONT)                                 G0019530
ISN      1160   76243   CONTINUE                                                                G0019540
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                 *....*...1.........2.........3.........4.........5.........6.........7.*.......8
ISN      1161           IF (XMOLE(1,MFRONT).GT.0.8D0) XMOLE(1,MFRONT)=0.8D0                     G0019550
ISN      1163           XMOLE(3,MFRONT)=ONE-XMOLE(1,MFRONT)-XMOLE(2,MFRONT)                     G0019560
ISN      1164   76245   CONTINUE                                                                G0019570
ISN      1165           NITRS3=NITRS3+1                                                         G0019580
ISN      1166           ICNT=ICNT+1                                                             G0019590
ISN      1167           IF(ICNT.GT.ITMAX)GO TO 212                                              G0019600
ISN      1168           REPESC=REPEAT                                                           G0019610
ISN      1169           REPEAT=REPEPT.OR.REPESC                                                 G0019620
ISN      1170           IF (.NOT.SWIT3) WRITE(ITMDSK,56104)ITIME,ITERAT,JCSMPT,JCSMSC,          G0019630
                     1                        (DELCPU(ICHECK),ICHECK=1,14)                     G0019640
ISN      1172   56104 FORMAT(1X,2I3,1X,L1,1X,L1,1X,L1,3X,14F8.4)                               G0019650
                CCC        IF(REPEAT)GO TO 210 IS DELETED.                                     G0019660
                CCC                                                                            G0019670
                CCC        ********************************************************            G0019680
                CCC        ***** END OF SATURATION-COMPOSITION ITERATION *****                G0019690
                CCC        ********************************************************            G0019700
                CCC                                                                            G0019710
ISN      1173           END IF                                                                  G0019720
                C                                                                              G0019730
ISN      1174           ITSC(ITERAT)=ICNT-1                                                     G0019740
                CCC                                                                            G0019750
                CCC    2.  CALCULATION OF REMAINING SATURATIONS & COMPOSITIONS FROM ALGEBRAI    G0019760
                CCC            EXPRESSIONS AFTER CONVERGENCE OF ITERATION                      G0019770
                CCC                                                                            G0019780
ISN      1175           BIG=0.D0                                                                G0019790
ISN      1176           DO 211 I=1,NG                                                           G0019800
ISN      1177           X1=DABS(SGP(I)-OSGP(I))*100.D0                                          G0019810
ISN      1178           IF(X1.GT.BIG)BIG=X1                                                     G0019820
ISN      1180           X1=DABS(SWP(I)-OSWP(I))*100.D0                                          G0019830
ISN      1181           IF(X1.GT.BIG)BIG=X1                                                     G0019840
ISN      1183           X1=DABS(SOP(I)-OSOP(I))*100.D0                                          G0019850
ISN      1184           IF(X1.GT.BIG)BIG=X1                                                     G0019860
ISN      1186   211     CONTINUE                                                                G0019870
ISN      1187           IF (TRACKF.AND.NDIMNS.LE.1) DDX=DABS(DISTX(MFRONT)-ODISXM)/             G0019880
                     1                                 (DX(MFRONT-1)+DX(MFRONT))               G0019890
                CCC                                                                            G0019900
                CCC    23.  DETERMINATION OF EQUILIBRIUM/NON-EQUILIBRIUM AT EACH GRID POINT    G0019910
                CCC                                                                            G0019920
ISN      1189           CHANGE=.FALSE.                                                          G0019930
ISN      1190           OVTAKE=.FALSE.                                                          G0019940
ISN      1191           IF (NDIMNS.LE.1) THEN                                                   G0019950
ISN      1192              IF(.NOT.OUT.AND.VAPINJ(1).LT.1.D-10)EQUIL(1)=.FALSE.                 G0019960
ISN      1194              IF(.NOT.OUT.AND.VAPINJ(1).GT.1.D-10)EQUIL(1)=.TRUE.                  G0019970
ISN      1196              DO 80 I=1,NG                                                         G0019980
                CC                 THIS COULD MAKE TROUBLE IF P(1) CHANGES                     G0019990
                CC                 DURING A SIMULATION.                                        G0020000
ISN      1197                 IF(EQUIL(I).AND..NOT.OEQUIL(I))CHANGE=.TRUE.                     G0020010
ISN      1199        80       CONTINUE                                                         G0020020
ISN      1200              OVTAKE=TRACKF.AND.                                                   G0020030
                         1    ((DISTX(MFRONT).GT.DISTX(MFRONT+1)).OR.                          G0020040
                         2     (DISTX(MFRONT-1).GT.ODISTX(MFRONT-1)))                          G0020050
ISN      1201           END IF                                                                  G0020060
ISN      1202           I1=1                                                                    G0020070
ISN      1203           IF (SWIT2.AND..NOT.SWIT6) WRITE(6,49111)I1,(P(IK),IK=1,6)               G0020080
ISN      1205           IF (SWIT2) GO TO 49130                                                  G0020090
ISN      1206   49109   FORMAT(' IT= ',I2)                                                      G0020100
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                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
ISN     1207   49110 FORMAT(' DT= ',F12.3,'  TIME= ',F12.1)                                    G0020110
ISN     1208   49111 FORMAT(I2,'  P= ',6(F12.4,6X))                                           G0020120
ISN     1209   49112 FORMAT(I2,'  T= ',6(F12.7,6X))                                           G0020130
ISN     1210   49113 FORMAT(I2,'  R= ',6(D16.9,2X))                                          G0020140
ISN     1211   49114 FORMAT(I2,' SG= ',6(F12.9,6X))                                          G0020150
ISN     1212   49115 FORMAT(I2,' SO= ',6(F12.9,6X))                                          G0020160
ISN     1213   49116 FORMAT(I2,' SM= ',6(F12.9,6X))                                          G0020170
ISN     1214   49117 FORMAT(I2,' XO= ',6(F12.9,6X))                                          G0020180
ISN     1215   49118 FORMAT(I2,' FR= ',6(F12.9,6X))                                          G0020190
ISN     1216   49119 FORMAT(I2,' BV= ',6(D16.9,2X))                                          G0020200
ISN     1217   49120 FORMAT(' AINJV= ',D16.9,'  PRODV= ',D16.9,                              G0020210
                     1    '  FRONT LOCATION=',F13.8)                                        G0020220
ISN     1218   49121 FORMAT('  FPD=',6(F13.8,5X))                                           G0020230
ISN     1219   49122 FORMAT('  FPX=',6(F13.8,5X))                                           G0020240
ISN     1220   49123 FORMAT('  FPY=',6(F13.8,5X))                                           G0020250
ISN     1221   49124 FORMAT(' FRND=',6(F13.8,5X))                                          G0020260
ISN     1222         I1=1                                                                   G0020270
ISN     1223         I2=2                                                                   G0020280
ISN     1224         I3=3                                                                   G0020290
ISN     1225         WRITE (6,49110)    DT,TIME                                             G0020300
ISN     1226         WRITE (6,49109)ITERAT                                                  G0020310
ISN     1227         WRITE (6,49111)I1,(   P(IK),IK=01,06)                                  G0020320
ISN     1228         WRITE (6,49111)I2,(   P(IK),IK=07,12)                                  G0020330
ISN     1229         WRITE (6,49111)I3,(   P(IK),IK=13,17)                                  G0020340
ISN     1230         WRITE (6,49112)I1,(   T(IK),IK=01,06)                                  G0020350
ISN     1231         WRITE (6,49112)I2,(   T(IK),IK=07,12)                                  G0020360
ISN     1232         WRITE (6,49112)I3,(   T(IK),IK=13,17)                                  G0020370
ISN     1233         WRITE (6,49113)I1,(   R(IK),IK=01,06)                                  G0020380
ISN     1234         WRITE (6,49114)I1,( SGP(IK),IK=01,06)                                  G0020390
ISN     1235         WRITE (6,49114)I2,( SGP(IK),IK=07,12)                                  G0020400
ISN     1236         WRITE (6,49115)I1,( SOP(IK),IK=01,06)                                  G0020410
ISN     1237         WRITE (6,49115)I2,( SOP(IK),IK=07,12)                                  G0020420
ISN     1238         WRITE (6,49115)I3,( SOP(IK),IK=13,17)                                  G0020430
ISN     1239         WRITE (6,49116)I1,( SMP(IK),IK=01,06)                                  G0020440
ISN     1240         WRITE (6,49116)I2,( SMP(IK),IK=07,12)                                  G0020450
ISN     1241         WRITE (6,49116)I3,( SMP(IK),IK=13,17)                                  G0020460
ISN     1242         WRITE (6,49117)I1,(XMOLE(1,IK),IK=01,06)                               G0020470
ISN     1243         WRITE (6,49117)I2,(XMOLE(1,IK),IK=07,12)                               G0020480
ISN     1244         WRITE (6,49117)I3,(XMOLE(1,IK),IK=13,17)                               G0020490
ISN     1245         WRITE (6,49118)I1,(FRDSM(IK),IK=01,06)                                 G0020500
ISN     1246         WRITE (6,49118)I2,(FRDSM(IK),IK=07,12)                                 G0020510
ISN     1247         WRITE (6,49119)I1,(BVFLOW(IK),IK=1,06)                                 G0020520
ISN     1248         WRITE (6,49119)I2,(BVFLOW(IK),IK=7,12)                                 G0020530
ISN     1249         IF (NDIMNS.LT.1) WRITE (6,49120) AINJV, PRODV, DISTX(MFRONT)           G0020540
ISN     1251         IF (NFPTOT.GT.0.AND..NOT.COORTR) THEN                                  G0020550
ISN     1252            WRITE (6,49121)(FPDIST(IK),IK=1,NFPTOT)                             G0020560
ISN     1253            WRITE (6,49122)(FPDISX(IK),IK=1,NFPTOT)                             G0020570
ISN     1254            WRITE (6,49123)(FPDISY(IK),IK=1,NFPTOT)                             G0020580
ISN     1255         END IF                                                                 G0020590
ISN     1256         IF (COORTR) WRITE (6,49124)(FRNDIS(IK),IK=1,NOS)                       G0020600
                C    CALL OUTPT1(.TRUE.) WAS DISABLED.                                      G0020610
ISN     1258   49130 CONTINUE                                                              G0020620
ISN     1259         WRITE (6,49119)I1,(BVFLOW(IK),IK=1,06)                                 G0020630
ISN     1260         IF(.NOT.(CHANGE.OR.OVTAKE).AND.(ITIME.NE.ISTOP.OR.ITERAT.LT.IEND))GO TO 1999  G0020640
                                                                                            G0020650
ISN     1261         IF ((CHANGE.OR.OVTAKE).AND.EQCHEK) GO TO 1993                          G0020660
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                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
ISN     1262   2609  CONTINUE                                                              G0020670
ISN     1263    2618 CONTINUE                                                              G0020680
ISN     1264    2619 CONTINUE                                                              G0020690
ISN     1265    2620 CONTINUE                                                              G0020700
ISN     1266         IF(IERRCT.GE.MAXERR)GO TO 218                                         G0020710
ISN     1267         IF (IERRPR.GE.3) GO TO 222                                            G0020720
ISN     1268         IF (ERRSCO.GE.ERULCO) GO TO 232                                       G0020730
ISN     1269         IF (ISTIT.GE.ILITER) GO TO 1191                                       G0020740
ISN     1270         BACKUP=.TRUE.                                                         G0020750
ISN     1271         DO 84 I=1,NGRPS                                                       G0020760
ISN     1272            P(I)=OP(I)                                                         G0020770
ISN     1273            T(I)=OT(I)                                                         G0020780
ISN     1274            SMP(I)=OSMP(I)                                                     G0020790
ISN     1275            SOP(I)=OSOP(I)                                                     G0020800
ISN     1276            SGP(I)=OSGP(I)                                                     G0020810
ISN     1277            XMOLE(1,I)=OXMOLE(1,I)                                             G0020820
ISN     1278            XMOLE(2,I)=OXMOLE(2,I)                                             G0020830
ISN     1279            XMOLE(3,I)=OXMOLE(3,I)                                             G0020840
                C       YS(I)=OYS(I) WAS DELETED.                                          G0020850
                C       YO(I)=OYO(I) WAS DELETED.                                          G0020860
                C       YV(I)=OYV(I) WAS DELETED.                                          G0020870
ISN     1280            YMOLE(4,I)=OYMOLE(4,I)                                             G0020880
ISN     1281            YMOLE(1,I)=OYMOLE(1,I)                                             G0020890
ISN     1282            YMOLE(2,I)=OYMOLE(2,I)                                             G0020900
ISN     1283            EQUIL(I)=OEQUIL(I)                                                 G0020910
ISN     1284            DGP(I)=ODGP(I)                                                     G0020920
ISN     1285            DMP(I)=ODMP(I)                                                     G0020930
ISN     1286            DOP(I)=ODOP(I)                                                     G0020940
ISN     1287            PHI(I)=OPHI(I)                                                     G0020950
ISN     1288            IENTI(I)=OIENTI(I)                                                 G0020960
ISN     1289            IENTXM(I)=OIENXM(I)                                                G0020970
ISN     1290            IENTSM(I)=OIENSM(I)                                                G0020980
ISN     1291            IENTSL(I)=OIENSL(I)                                                G0020990
ISN     1292            R(I)=OR(I)                                                         G0021000
ISN     1293            D(I)=OD(I)                                                         G0021010
ISN     1294            V(I)=OV(I)                                                         G0021020
ISN     1295      84 CONTINUE                                                              G0021030
ISN     1296         IF (NDIMNS.GE.2) THEN                                                 G0021040
ISN     1297            DO 985 JB=1,NBNDBS                                                 G0021050
ISN     1298               BVFLOW(JB)=OBVFLO(JB)                                           G0021060
ISN     1299      985    CONTINUE                                                         G0021070
ISN     1300            IF (COORTR) THEN                                                   G0021080
ISN     1301               DO 986 JO=1,NOS                                                 G0021090
ISN     1302                  FRNDIS(JO)=(ONE+VFFCTR*0.25D0*DT)*OFRNDS(JO)                 G0021100
ISN     1303      986       CONTINUE                                                       G0021110
ISN     1304               ELSE                                                            G0021120
ISN     1305               DO 987 JFP=1,NFPTOT                                             G0021130
ISN     1306                  FPDIST(JFP)=OFDIST(JFP)                                      G0021140
ISN     1307      987       CONTINUE                                                       G0021150
ISN     1308            END IF                                                           G0021160
ISN     1309         END IF                                                              G0021170
ISN     1310         IF (NDIMNS.LE.1) THEN                                               G0021180
ISN     1311            AINJV=OAINJV                                                     G0021190
ISN     1312            PRODV=OPRODV                                                     G0021200
ISN     1313            IF (TRACKF) THEN                                                 G0021210
ISN     1314               DISTX(MFRONT)=ODISTX(MFRONT)                                  G0021220
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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
ISN     1315                DX(MFRONT-1)=DISTX(MFRONT)-DISTX(MFRONT-1)                          G0021230
ISN     1316                DX(MFRONT)  =DISTX(MFRONT+1)-DISTX(MFRONT)                        G0021240
ISN     1317              END IF                                                              G0021250
ISN     1318            END IF                                                                G0021260
                C  IT IS NOT NECESSARY TO BACK UP FLINJ AND FLPRD.                            G0021270
                C                                                                             G0021280
ISN     1319            IERRA=IERR                                                            G0021290
ISN     1320            IERR=0                                                                G0021300
ISN     1321            CALL PROPTY(1,NGRPS,4,0)                                              G0021310
                C             I.E. CALL SUBROUTINE PROPTY(ISTART,IFINIS,LCTNPH,IJOB)          G0021320
ISN     1322            IF (IERR.NE.0) GO TO 218                                              G0021330
                C               GO TO 2618 COULD CONCEIVABLY CAUSE AN INFINITE LOOP.          G0021340
                C                                                                             G0021350
ISN     1323            TIME=TIME-DT                                                          G0021360
ISN     1324            IF (REPEAT.AND.ITERAT.GE.IEND) GO TO 2611                             G0021370
ISN     1325            IF (IERRA.NE.0.AND.IERRCT.LT.MAXERR) GO TO 2607                       G0021380
ISN     1326            IF(IOOPS.NE.0.AND.IERRPR.LT.3)GO TO 3242                              G0021390
ISN     1327            IF (ERYMCO.NE.0.AND.ERRSCO.LT.ERULCO) GO TO 3244                      G0021400
ISN     1328            IF (ITIME.GE.ISTOP) GO TO 3252                                        G0021410
ISN     1329            IF (CLOSE.AND..NOT.OVTAKE) DT=DT*0.65D0                               G0021420
ISN     1331            IF (.NOT.(CHANGE.OR.OVTAKE)) GO TO 1992                               G0021430
ISN     1332            EQCHEK=.TRUE.                                                         G0021440
ISN     1333            OVTAKE=.FALSE.                                                        G0021450
ISN     1334            CALL HARN(2)                                                          G0021460
ISN     1335            DT=DT*CHREDU                                                          G0021470
ISN     1336            GO TO 1992                                                            G0021480
ISN     1337    2607    DT=DT*SMALLR                                                          G0021490
ISN     1338            CALL HARN(5)                                                          G0021500
ISN     1339            IERRCT=IERRCT+1                                                       G0021510
ISN     1340            IF (ITABL.EQ.0) CALL ERRMSG(4,LCTN,IWRONG,SWPDUM,SGPDUM)              G0021520
                C             I.E. CALL ERRMSG(L,I1,I2,R1,R2)                               G0021530
ISN     1342            IF (ITABL.GT.0) ITABL=0                                               G0021540
ISN     1344            GO TO 1992                                                            G0021550
ISN     1345    2611    DT=DT*(SMALLR*SMALLR)                                                 G0021560
ISN     1346            CALL HARN(3)                                                          G0021570
ISN     1347            GO TO 1992                                                            G0021580
ISN     1348    3242    DT=DT*0.25D0                                                          G0021590
ISN     1349            CALL HARN(6)                                                          G0021600
ISN     1350            IERRPR=IERRPR+1                                                       G0021610
ISN     1351            GO TO 1992                                                            G0021620
ISN     1352    3244    DT=DT*0.25D0                                                          G0021630
ISN     1353            CALL HARN(7)                                                          G0021640
ISN     1354            ERRSCO=ERRSCO+1                                                       G0021650
ISN     1355            GO TO 1992                                                            G0021660
ISN     1356    3252    CONTINUE                                                              G0021670
ISN     1357            DT=DT*0.5D0                                                           G0021680
ISN     1358            ISTIT=ISTIT+1                                                         G0021690
ISN     1359            IJKLMN=2000                                                           G0021700
                C             THIS SUPPRESSES THE REGULAR OUTPUT EVERY IINTVL TIME STEPS.     G0021710
                C             (AS OF 1986/09/04, IINTVL EQUALS 3)                             G0021720
ISN     1360            GO TO 1992                                                            G0021730
ISN     1361    1993    IEND=IENDEQ                                                           G0021740
ISN     1362            CALL HARN(4)                                                          G0021750
ISN     1363    1999    IF (REPEAT.AND.ITERAT.LT.IEND) GO TO 1998                             G0021760
ISN     1364            IF (REPEAT.AND.ITERAT.GE.IEND) GO TO 2609                             G0021770
                C                                                                             G0021780
```



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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
                CCCCC                        ********************************                 G0021790
                CCCCC                        ***** END OF OUTER ITERATION *****               G0021800
                CCCCC                        ********************************                 G0021810
                CCCCC  IF THE FLOW OF CONTROL ARRIVES HERE,                                   G0021820
                CCCCC  THE TIME STEP CALCULATIONS HAVE BEEN SUCCESSFULLY PERFORMED.           G0021830
ISN     1365            ODT=DT                                                                G0021840
                C                                                                             G0021850
ISN     1366            IF (CHANGE.OR.OVTAKE) EQCHEK=.FALSE.                                  G0021860
ISN     1368            OVTAKE=.FALSE.                                                        G0021870
                C                                                                             G0021880
ISN     1369            CALL PROPTY(1,NGRPS,3,0)                                              G0021890
                C             I.E. CALL SUBROUTINE PROPTY(ISTART,IFINIS,LCTNPH,IJOB)          G0021900
ISN     1370            IF (IERR.NE.0) GO TO 2618                                             G0021910
                CCCCC                                                                         G0021920
                CCCCC                                                                         G0021930
                CCCCC                                                                         G0021940
                CCCCC                I.E. CALL SUBROUTINE BLOKS1(NFPTMX,NGRPMX,FPDIST,        G0021950
                CCCCC                                            FPDISX,FPDISY,FPDSNM,GPX,GPY) G0021960
                CCCCC                I.E. CALL SUBROUTINE BLOKS2(OUTP,NBLKMX,BLCORX,BLCORY,BLSPEC)G0021970
                CCCCC                                           ,LCAREA,BLAREA)               G0021980
                CCCCC                I.E. CALL EDGCLC(NEDGMX,NBNDMX,                          G0021990
                CCCCC                                 EDSTAX,EDSTAY,EDFINX,EDFINY,FLFR)       G0022000
                CCCCC                                                                         G0022010
                CCCCC                JUST IN CASE THE CALL TO ARTRNF WILL BE REMOVED FROM ACUMCL:G0022020
                CCCCC                (DON'T FORGET TO DECLARE AREATR ET AL.                   G0022030
                CCCCC                 BEFORE ACTIVATING THE FOLLOWING:)                       G0022040
                CCCCC                                                                         G0022050
                CCCCC              CALL ARTRNF(INITLZ,TEST,NFPTMX,NATRMX,NARTRS,SCAREA, DISABLED.G0022060
                CCCCC             1                AREATR,JRARTR,JDARTR,JFARTR) TEMPORARILY DISABLED.G0022070
                CCCCC                I.E. CALL ARTRNF(INITLZ,TEST,NFPTMX,NATRMX,SCAREA,NARTRS,G0022080
                CCCCC             1                AREATR,JRARTR,JDARTR,JFARTR)               G0022090
                CCCCC                                                                         G0022100
ISN     1371            IF (NDIMNS.GE.2) THEN                                                 G0022110
ISN     1372              NCALCS=NGRPS                                                        G0022120
ISN     1373              DO 4140 JCALC=1,NCALCS                                              G0022130
ISN     1374                GRPLIS(JCALC)=JCALC                                               G0022140
ISN     1375    4140      CONTINUE                                                            G0022150
                C                                                                             G0022160
ISN     1376              CALL ACUMCL(.TRUE.,.TRUE.,.TRUE.,                                   G0022170
                1                   NFPTMX,NGRPMX,NATRMX,NCOMPS,NBALNS,                     G0022180
                2                   NCALCS,GRPLIS,ENMCFO,VOLCFO,                            G0022190
                3                   CONCL,CONCV,SCAREA,ACCUMO,ACUMFO)                       G0022200
                CCCCC                  I.E. CALL ACUMCL(ALGRPS,INITLZ,TEST,                 G0022210
                CCCCC                                   NFPTMX,NGRPMX,NATRMX,NCOMPS,NBALNS, G0022220
                CCCCC                                   NCALCS,GRPLIS,ENMCF,VOLCF           G0022230
                CCCCC                                   CONCL,CONCV,SCAREA,ACCUM,ACUMF)     G0022240
                CCCCC                                                                       G0022250
ISN     1377            END IF                                                              G0022260
                C                                                                           G0022270
                C                                                                           G0022280
ISN     1378    3801    FORMAT(' -FPD: FPDIST=',6(F13.8,5X))                                G0022290
ISN     1379    3802    FORMAT(' -FPX: FPDISX=',6(F13.8,5X))                                G0022300
ISN     1380    3803    FORMAT(' -FPY: FPDISY=',6(F13.8,5X))                                G0022310
ISN     1381            IF (NFPTOT.GT.0.AND. .NOT.COORTR) THEN                              G0022320
ISN     1382              WRITE(6,3801)(FPDIST(IK),IK=1,NFPTOT)                             G0022330
                                                                                            G0022340
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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8

ISN     1383            WRITE(9,3801)(FPDIST(IK),IK=1,NFPTOT)                                   GO022350
ISN     1384            WRITE(6,3802)(FPDISX(IK),IK=1,NFPTOT)                                   GO022360
ISN     1385            WRITE(6,3803)(FPDISY(IK),IK=1,NFPTOT)                                   GO022370
ISN     1386          END IF                                                                    GO022380
ISN     1387        DTEX=DT                                                                     GO022390
ISN     1388        IF (BIG.GT.BIGMAX.OR.DDX.GT.DDXMAX) DTEX=DTEX*SMALLR                        GO022400
ISN     1390        IF ((BIG.LT.BIGMIN.AND.DDX.LT.DDXMIN)                                       GO022410
                1       .AND..NOT.EQCHEK.AND.ITERAT.LT.MAXO(6,IENDNL/2))                        GO022420
                2 DTEX=DTEX*BIGGER                                                              GO022430
ISN     1392        IF (DTEX.GT.DTMAX) DTEX=DTMAX                                               GO022440
                C       DXFRNT HAS ALREADY BEEN DEFINED AT LEAST ONCE.                          GO022450
ISN     1394        IF (TRACKF.AND.NDIMNS.LE.1) DXFRNT=DISTX(MFRONT)-DISTX(MFRONT-1)            GO022460
ISN     1396        DATAFR=TRACKF                                                               GO022470
ISN     1397        J6=24                                                                       GO022480
ISN     1398        XNUM=ZERO                                                                   GO022490
ISN     1399        WRITE(3,80025)NBLOKS,TRACKF,DATAFR,DDXMAX,DDXMIN,MFRONT,DXFRNT              GO022500
ISN     1400        WRITE(3,8003)NRSTRT,IJKLMN,DTEX,DTCUTO,DTMAX,TIME                           GO022510
ISN     1401        IF (NDIMNS.GE.2.AND..NOT.COORTR)                                            GO022520
                1 WRITE(3,8005)(JFP,FPHV(JFP),FPJX(JFP),FPJY(JFP),XNUM,                         GO022530
                2                J6,FPDIST(JFP),JFP=1,NFPTOT)                                   GO022540
ISN     1403        IF (NDIMNS.GE.2.AND.COORTR) THEN                                            GO022550
ISN     1404          IF (L2SYMM) THEN                                                          GO022560
ISN     1405            JU1=2                                                                   GO022570
ISN     1406            JUN=NOS-1                                                               GO022580
ISN     1407          ELSE                                                                      GO022590
ISN     1408            JU1=1                                                                   GO022600
ISN     1409            JUN=NOS                                                                 GO022610
ISN     1410          END IF                                                                    GO022620
ISN     1411        JU1P1=JU1+1                                                                 GO022630
ISN     1412        JUNM1=JUN-1                                                                 GO022640
ISN     1413        WRITE(3,80051)FRNDIS(JU1)                                                   GO022650
ISN     1414        WRITE(3,80052)(BLOCKO(J),FRNDIS(J),J=JU1P1,JUNM1)                           GO022660
ISN     1415        WRITE(3,80053) BLOCKO(JUN),FRNDIS(JUN)                                      GO022670
ISN     1416      END IF                                                                        GO022680
ISN     1417      WRITE(3,8007)CUMENL,CUMMAT,CUMSVL,CUMVOL,CUMINT,CUMPVI                        GO022690
ISN     1418      WRITE(3,8007)CUMENG,CUMSTM,CUMSVG,CUMVOG                                      GO022700
ISN     1419      WRITE(3,8008)PRDENL,PRDMAT,PRDSVL,PRDVOL,PRDINT                               GO022710
ISN     1420      WRITE(3,8008)PRDENG,PRDSTM,PRDSVG,PRDVOG                                      GO022720
                C                                                                               GO022730
ISN     1421      CALL OUTDSK                                                                   GO022740
                C                                                                               GO022750
ISN     1422      WRITE(6,1724)NITRS1,NITRS2,NITRS3                                             GO022760
ISN     1423    11111 CONTINUE                                                                  GO022770
                C                                                                               GO022780
                C                                *********************************              GO022790
                C                                ***** END OF TIME LEVEL J *****                GO022800
                C                                *********************************              GO022810
                C                                                                               GO022820
                C                                                                               GO022830
                C  24.  INFORMATION OUTPUT FOR ABNORMAL RUN TERMINATION                         GO022840
                C                                                                               GO022850
ISN     1424      216 WRITE(6,217)IEND                                                          GO022860
ISN     1425      217 FORMAT('1',58('*'),/1X,'***  NO CONVERGENCE ON THE COMBINED P-T-S-       GO022870
                1X ITERATION  ***',/1X,3('*'),14X,I2,' ITERATIONS COMPLETED',15X,              GO022880
                23('*'),/1X,58('*'))                                                            GO022890
ISN     1426        GO TO 1191                                                                  GO022900
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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8

ISN     1427      214   WRITE(6,215)ITMAX                                                       GO022910
ISN     1428      215   FORMAT('1',58('*'),/1X,'***  NO CONVERGENCE ON PRESSURE-TEMPERATUR     GO022920
                1E ITERATION  ***',/1X,3('*'),14X,I2,' ITERATIONS COMPLETED',15X,              GO022930
                23('*'),/1X,58('*'))                                                            GO022940
ISN     1429        GO TO 1191                                                                  GO022950
ISN     1430      212   WRITE(6,213)ITMAX                                                       GO022960
ISN     1431      213   FORMAT('1',60('*'),/1X,'***  NO CONVERGENCE ON SATURATION-COMPOSIT     GO022970
                1ION ITERATION  ***',/1X,3('*'),15X,I2,' ITERATIONS COMPLETED',                 GO022980
                21X,3('*'),/1X,60('*'))                                                         GO022990
ISN     1432        GO TO 1191                                                                  GO023000
ISN     1433      218   WRITE(6,219)SMPDUM,SGPDUM,LCTN,INRONG                                   GO023010
ISN     1434        IF (ITABL.GT.0) GO TO 226                                                   GO023020
ISN     1435      219   FORMAT('1',45('*'),/1X,'***  AN OUT-OF-RANGE ERROR HAS OCCURRED.       GO023030
                1***',/1X,'*** SMP = ',G11.4,2X,'SGP = ',G11.4,2X,'***',/1X,                    GO023040
                2'*** PRGM LOCATION = ',I2,2X,'GRID POINT = ',I2,'  ***',/1X,                   GO023050
                345('*'))                                                                       GO023060
ISN     1436        GO TO 1191                                                                  GO023070
ISN     1437      222   WRITE(6,223)P(1),P(3)                                                   GO023080
ISN     1438      223   FORMAT('1',34('*'),/1X,'*** ABNORMAL PRESSURE AT I = 2 ***',           GO023090
                1(1X,'***    P(1) = ',G13.6,'    ***',/1X,'***    P(3) = ',G13.6,             GO023100
                2'    ***',/1X,34('*'))                                                         GO023110
ISN     1439        GO TO 1191                                                                  GO023120
ISN     1440      224   WRITE(6,225)DTEX,DT                                                     GO023130
ISN     1441      225   FORMAT('1',34('*'),/1X,'***  DTEX DOES NOT EQUAL DT  ***'             GO023140
                1(1X,'***   DTEX = ',G13.6,'    ***',/1X,'***     DT  = ',G13.6,              GO023150
                2'    ***',/1X,34('*'))                                                         GO023160
ISN     1442        GO TO 1191                                                                  GO023170
ISN     1443      226 WRITE(6,227)ITABL                                                         GO023180
ISN     1444      227 FORMAT('1',34('*'),/' ***          THE ABSCISSA         ***',          GO023190
                1 /1X,'***     IS OUTSIDE THE RANGE     ***'                                   GO023200
                2 /1X,'***          OF TABLE ',I1,'          ***',/1X,34('*'))                  GO023210
ISN     1445        GO TO 1191                                                                  GO023220
ISN     1446      228 WRITE(6,229)                                                              GO023230
ISN     1447      229 FORMAT('1',34('*'),/' *** SORRY, THE PROGRAM CAN NOT ***'/                GO023240
                1 1X,'***HANDLE PERCENTAGES BY WEIGHT***'/1X,34('*'))                           GO023250
                C       GO TO 1191 WAS DELETED.                                                 GO023260
                C  230 WRITE(6,231) WAS MOVED TO INPUT4.                                        GO023270
                C  231 FORMAT('1',34('*'),/' *** THE SATS SUBROUTINE FAILED ***',               GO023280
                C     1 /1X,34('*')) WAS ALL MOVED TO INPUT4.                                   GO023290
ISN     1448        GO TO 1191                                                                  GO023300
ISN     1449      232 WRITE(6,233)                                                              GO023310
ISN     1450      233 FORMAT('1',34('*'),/' *** THE CONDITION NUMBER RCOND ***'/                GO023320
                1 1X,'***   IS CONSISTENTLY TOO SMALL.***'/1X,34('*'))                         GO023330
ISN     1451    1191  TIME=TIME-DT                                                            GO023340
                C     IF(.NOT.PUNCH)GO TO 1192 WAS DELETED.                                     GO023350
                C     DO 8013 I=1,NJAY WAS DELETED.                                             GO023360
                C     WRITE(7,8014)OP(I),OT(I),OR(I),OO(I),OV(I) WAS DELETED.                   GO023370
                C8013 WRITE(7,8014)OXO(I),OXW(I),OSMP(I),OSOP(I) WAS DELETED.                   GO023380
                C8014 FORMAT(5D13.6) WAS DELETED.                                               GO023390
                C     WRITE(6,8080) WAS DELETED.                                                GO023400
                C8080 FORMAT('0',10(/1X),43('*'),/1X,'***  PUNCHED OUTPUT GENERATED FOR         GO023410
                C    1LAST  ***',/1X,'***',9X,'SUCCESSFUL TIME STEP',8X,'***',/1X,              GO023420
                C    243('*')) WAS DELETED.                                                     GO023430
ISN     1452    1192  CALL OUTPT1(.FALSE.)                                                    GO023440
ISN     1453    119   CONTINUE                                                                GO023450
ISN     1454          END FILE 3                                                              GO023460
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LEVEL 1.4.1 (MAY 1985)          VS FORTRAN          DATE: AUG 24, 1988    TIME: 11:56:10      NAME: GOOEY   PAGE:   43

                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
                C     WRITE(6,1980)  WAS DELETED.                                                 G0023470
ISN     1455    C     STOP                                                                        G0023480
ISN     1456          END                                                                         G0023490
*STATISTICS*   SOURCE STATEMENTS = 1351, PROGRAM SIZE = 956168 BYTES, PROGRAM NAME = GOOEY    PAGE:    1.
*STATISTICS*    NO DIAGNOSTICS GENERATED.
**GOOEY** END OF COMPILATION 1 ******
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LEVEL 1.4.1 (MAY 1985)          VS FORTRAN          DATE: AUG 24, 1988    TIME: 11:56:31                PAGE:   44
OPTIONS IN EFFECT:  NOLIST NOMAP NOXREF NOGOSTMT NODECK   SOURCE   TERM NOOBJECT FIXED  NOTEST   TRMFLG   SRCFLG
                    NOSYM NORENT   SDUMP AUTODBL(NONE)   NOSXM    IL
                      OPT(0) LANGLVL(77) NOFIPS   FLAG(I)   NAME(MAIN  )  LINECOUNT(60)      CHARLEN(500)

                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
                C.SWITCH                                                                          G0023500
                CCC  S00.  SWITCH NFRONT AND NFRONT+1                                             G0023510
                C                                                                                 G0023520
ISN         1         SUBROUTINE SWITCH                                                           G0023530
ISN         2         IMPLICIT DOUBLE PRECISION (A-H,K,O-Z)                                       G0023540
                C                                                                                 G0023550
                C                                                                                 G0023560
ISN         3         LOGICAL EQMA01,EQMA10,VOUCPT,VOUCSC,EQUIL                                   G0023570
ISN         4         LOGICAL COORTR,TRACKF,OVTAKE,DATAFR,RESTRT                                  G0023580
                C                                                                                 G0023590
ISN         5         COMMON/PVAPOR/PMAT(55),POIL(55),PSOL(55),DPMAT(55),DPOIL(55),               G0023600
                     1          DPSOL(55),DPDT(55),YMOLE(4,55),YO(55),YV(55),YS(55)             G0023610
ISN         6         COMMON/EQLBRM/PEQUIL,                                                       G0023620
                     1          EQMA01,EQMA10,VOUCPT,VOUCSC,EQUIL(55)                           G0023630
ISN         7         COMMON/VPCONS/AH,BM,AO,BO,CO,ASOL,BSOL,CSOL,TO(55)                          G0023640
ISN         8         COMMON/GRIPRO/DT,DXFRNT,DISXM,DX(57),DISTX(58),NFRONT,NBLOKS,               G0023650
                     1          NG,NJAY,COORTR,TRACKF,OVTAKE,DATAFR,RESTRT                      G0023660
ISN         9         COMMON/STATEV/SMP(55),SGP(55),SOP(55),T(55),P(55),                          G0023670
                     1          XMOLE(3,55),XO(55),XSOL(55),XW(55)                              G0023680
ISN        10         COMMON/ADJSAT/FRDSW(55)                                                     G0023690
ISN        11         COMMON/OTERMS/QENTHP(55),QNATIP(55),QQILIP(55),QGASIP(55),                  G0023700
                     1          QEMFLX(55),QQISXM,QACUMB(9,4)                                   G0023710
ISN        12         COMMON/CTEMP1/WHCS                                                          G0023720
                C                                                                                 G0023730
ISN        13    102  FORMAT(' ****SWITCH IS BEING CALLED')                                      G0023740
ISN        14         WRITE(6,102)                                                                G0023750
                CCCCC      THIS SEQUENCE MUST BE LOCATED BEFORE THE DISTX'S ARE SWITCHED.        G0023760
                CCCCC      THIS DOES NOT FAIL UNTIL THE FRONT OVERTAKES THE POINT #NG.           G0023770
                CCCCC                                                                             G0023780
                CCCCC      FORMERLY 120 CONTINUE.                                                 G0023790
                CCCCC                                                                             G0023800
                CCCCC                                                                             G0023810
                CCCCC      I.E. CALL TEMPS(NFRONT,NORMAL,LCTN,IERR,IWRONG)                        G0023820
                CCCCC                                                                             G0023830
                C          FORMERLY 250 CONTINUE                                                  G0023840
ISN        15         RETURN                                                                      G0023850
ISN        16         END                                                                         G0023860
                                                                                                  G0023870
*STATISTICS*   SOURCE STATEMENTS = 16, PROGRAM SIZE = 1832 BYTES, PROGRAM NAME = SWITCH    PAGE:   44.
*STATISTICS*    NO DIAGNOSTICS GENERATED.
**SWITCH** END OF COMPILATION 2 ******
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OPTIONS IN EFFECT: NOLIST NOMAP NOXREF NOGOSTMT NODECK SOURCE TERM NOOBJECT FIXED NOTEST TRMFLG SRCFLG
NOSYM NORENT SDUMP AUTODBL(NONE) NOSXM IL
OPT(0) LANGLVL(77) NOFIPS FLAG(I) NAME(MAIN) LINECOUNT(60) CHARLEN(500)

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                    *....*...1.........2.........3.........4.........5.........6.........7.*.......8
                    C.HARN                                                                          G0023880
                    C                                                                               G0023890
                    C  S00.  PRINT WARNING MESSAGES.                                                G0023900
                    C                                                                               G0023910
ISN          1          SUBROUTINE HARN(L)                                                          G0023920
ISN          2          IMPLICIT DOUBLE PRECISION (A-H,K,O-Z)                                       G0023930
ISN          3          NMSGS=8                                                                     G0023940
ISN          4          IF (L.GT.NMSGS) GO TO 39990                                                 G0023950
ISN          5          GO TO (30010,30020,30030,30040,30050,30060,30070,30080),L                   G0023960
ISN          6    30010 WRITE(6,30011)                                                              G0023970
ISN          7    30011 FORMAT(' ***WARNING: OVTAKE IS TRUE AGAIN')                                 G0023980
ISN          8          RETURN                                                                      G0023990
ISN          9    30020 WRITE(6,30021)                                                              G0024000
ISN         10    30021 FORMAT(' ***WARNING: ABOUT TO BACK UP.',                                    G0024010
                     1       '  EQCHEK HAS BEEN SET TO .TRUE.')                                    G0024020
ISN         11          RETURN                                                                      G0024030
ISN         12    30030 WRITE(6,30031)                                                              G0024040
ISN         13    30031 FORMAT(' ***WARNING: ABOUT TO BACK UP',                                     G0024050
                     1       ' BECAUSE OF TOO MANY ITERATIONS')                                     G0024060
ISN         14          RETURN                                                                      G0024070
ISN         15    30040 WRITE(6,30041)                                                              G0024080
ISN         16    30041 FORMAT(' ***END OF ONE ITERATION TRYING TO PUSH THE FRONT',                 G0024090
                     1       ' PAST A GRID POINT')                                                  G0024100
ISN         17          RETURN                                                                      G0024110
ISN         18    30050 WRITE(6,30051)                                                              G0024120
ISN         19    30051 FORMAT(' ***WARNING: ABOUT TO BACK UP',                                     G0024130
                     1       ' BECAUSE OF IERR.')                                                   G0024140
ISN         20          RETURN                                                                      G0024150
ISN         21    30060 WRITE(6,30061)                                                              G0024160
ISN         22    30061 FORMAT(' ***WARNING: ABOUT TO BACK UP',                                     G0024170
                     1       ' BECAUSE THE PRESSURE GRADIENT',                                      G0024180
                     2       ' NEAR THE FRACTURE HAS REVERSED.')                                    G0024190
ISN         23          RETURN                                                                      G0024200
ISN         24    30070 WRITE(6,30071)                                                              G0024210
ISN         25    30071 FORMAT(' ***WARNING: ABOUT TO BACK UP',                                     G0024220
                     1       ' BECAUSE THE JACOBIAN IS ILL-CONDITIONED.')                           G0024230
ISN         26          RETURN                                                                      G0024240
ISN         27    30080 WRITE(6,30081)                                                              G0024250
ISN         28    30081 FORMAT(' ***WARNING: THERE IS A PROBLEM IN FRBAL.')                         G0024260
ISN         29          RETURN                                                                      G0024270
ISN         30    39990 WRITE(6,39991)L                                                             G0024280
ISN         31    39991 FORMAT(' ***WARNING #',I3)                                                  G0024290
ISN         32          RETURN                                                                      G0024300
ISN         33          END                                                                         G0024310
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STATISTICS SOURCE STATEMENTS = 33, PROGRAM SIZE = 1576 BYTES, PROGRAM NAME = HARN PAGE: 45.

STATISTICS NO DIAGNOSTICS GENERATED.

HARN END OF COMPILATION 3 *****

OPTIONS IN EFFECT: NOLIST NOMAP NOXREF NOGOSTMT NODECK SOURCE TERM NOOBJECT FIXED NOTEST TRMFLG SRCFLG
NOSYM NORENT SDUMP AUTODBL(NONE) NOSXM IL
OPT(0) LANGLVL(77) NOFIPS FLAG(I) NAME(MAIN) LINECOUNT(60) CHARLEN(500)

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                    *....*...1.........2.........3.........4.........5.........6.........7.*.......8
                    C.OUTDSK                                                                        G0024320
                    C                                                                               G0024330
                    C  S00.  WRITE THE STATE VARIABLES ET AL. ONTO DISK.                            G0024340
                    C                                                                               G0024350
ISN          1          SUBROUTINE OUTDSK                                                           G0024360
ISN          2          IMPLICIT DOUBLE PRECISION (A-H,K,O-Z)                                       G0024370
                    C                                                                               G0024380
ISN          3          LOGICAL LDUM1,LDUM2                                                         G0024390
                    C                                                                               G0024400
ISN          4          LOGICAL OUT,REPEAT,JCTEST,JTINIT,ITERPR,BYWEIT                              G0024410
ISN          5          LOGICAL LBNDOG,LBND8                                                        G0024420
ISN          6          LOGICAL RCOND,INJECT                                                        G0024430
                    C                                                                               G0024440
ISN          7          COMMON/INJSPC/PGRDNT,TOTINJ,VAPINJ(28),HCBINJ(28),WATINJ(28),               G0024450
                     1                 VLCITY,HC1INJ(28),HC2INJ(28),HC3INJ(28),                   G0024460
                     2                 VOINJ(28),VO2INJ(28),VWAINJ(28)                            G0024470
ISN          8          COMMON/LOGMIS/OUT,REPEAT,JCTEST,JTINIT,ITERPR,BYWEIT                        G0024480
ISN          9          COMMON/STATEV/SWP(55),SGP(55),SOP(55),T(55),P(55),                          G0024490
                     1                 XMOLE(3,55),XO(55),XSOL(55),XW(55)                         G0024500
ISN         10          COMMON/IBASCS/NULL                                                          G0024510
ISN         11          COMMON/TABLS1/NBLKS,NGRPS,JGRPOG(50),JAGPOF(9,16),                          G0024520
                     1                 JBLK(55),JFPT(55)                                          G0024530
ISN         12          COMMON/BTBLS1/NBND8S,JBNDOG(55),JBND8(50),JBLK08(28),JINT08(28)             G0024540
ISN         13          COMMON/BTBL1A/LBNDOG(55),LBND8(50)                                          G0024550
ISN         14          COMMON/SPEC3 /TSPEC(28),BSPEC(28),FSPEC(28)                                 G0024560
ISN         15          COMMON/SPEC4 /RCOND(28),INJECT(28)                                          G0024570
ISN         16          COMMON/BVOLFL/BVFLOW(28),FLFR(150)                                          G0024580
                    C                                                                               G0024590
ISN         17          DO 301 J=1,NGRPS                                                            G0024600
ISN         18             JBLKJ=JBLK(J)                                                            G0024610
ISN         19             IDUM1=2                                                                  G0024620
ISN         20             LDUM1=.FALSE.                                                            G0024630
ISN         21             LDUM2=.FALSE.                                                            G0024640
ISN         22             IF (JBLKJ.GT.NULL) LDUM1=LBND8(JBLKJ)                                    G0024650
ISN         24             WRITE(3,80110)LDUM1,IDUM1,P(J),T(J)                                      G0024660
ISN         25             WRITE(3,80111)LDUM2,XMOLE(1,J),XMOLE(2,J),SWP(J),SGP(J)                  G0024670
ISN         26    80110    FORMAT(1X,L1,I1,5D13.6)                                                  G0024680
ISN         27    80111    FORMAT(1X,L1,1X,5D13.6)                                                  G0024690
ISN         28             IF (LDUM1) THEN                                                          G0024700
ISN         29                JBND8J=JBND8(JBLKJ)                                                   G0024710
ISN         30                IF (RCOND(JBND8J)) THEN                                               G0024720
ISN         31                   BSPEC=FSPEC(JBND8J)                                                G0024730
ISN         32                ELSE                                                                  G0024740
ISN         33                   BSPEC=PSPEC(JBND8J)                                                G0024750
ISN         34                END IF                                                                G0024760
ISN         35                WRITE(3,80112)RCOND(JBND8J),INJECT(JBND8J),JINT08(JBND8J),            G0024770
                     1                      TSPEC(JBND8J),BSPEC,BVFLOW(JBND8J)                      G0024780
ISN         36    80112       FORMAT(1X,L1,1X,L1,3X,I3,F10.5,2D14.6)                               G0024790
ISN         37                IF (INJECT(JBND8J)) THEN                                              G0024800
ISN         38                   JB=JBND8J                                                          G0024810
ISN         39                   WRITE(3,80114)BYWEIT,WATINJ(JB),HCBINJ(JB),VAPINJ(JB),             G0024820
                     1                                HC1INJ(JB),HC2INJ(JB),HC3INJ(JB),             G0024830
```

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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
                                                                                                
                                                    VO1INJ(JB),VO2INJ(JB),VMAINJ(JB)            G0024840
ISN       40   80114^2        FORMAT(1X,L1,3(4X,3F7.4))                                          G0024850
ISN       41                 END IF                                                             G0024860
ISN       42               END IF                                                               G0024870
ISN       43     301 CONTINUE                                                                   G0024880
                C                                                                               G0024890
ISN       44           RETURN                                                                   G0024900
ISN       45           END                                                                      G0024910
*STATISTICS*   SOURCE STATEMENTS = 44, PROGRAM SIZE = 2956 BYTES, PROGRAM NAME = OUTDSK    PAGE:   46.
*STATISTICS*    NO DIAGNOSTICS GENERATED.
**OUTDSK** END OF COMPILATION 4 ******
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OPTIONS IN EFFECT:  NOLIST NOMAP NOXREF NOGOSTMT NODECK   SOURCE   TERM NOOBJECT FIXED  NOTEST   TRMFLG   SRCFLG
                    NOSYM NORENT   SDUMP AUTODBL(NONE)   NOSXM    IL
                      OPT(0) LANGLVL(77) NOFIPS   FLAG(I)   NAME(MAIN  )  LINECOUNT(60)      CHARLEN(500)

                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
                C.ERRMSG                                                                        G0024920
                C                                                                               G0024930
                C  500.  INFORMATION OUTPUT FOR ABNORMAL RUN TERMINATION.                       G0024940
                C                                                                               G0024950
ISN       1           SUBROUTINE ERRMSG(L,I1,I2,R1,R2)                                          G0024960
ISN       2           IMPLICIT DOUBLE PRECISION (A-H,K,O-Z)                                     G0024970
                C                                                                               G0024980
                C                                                                               G0024990
                C                                                                               G0025000
                C                                                                               G0025010
ISN       3           NMSGS=11                                                                  G0025020
ISN       4           IF (L.GT.NMSGS) GO TO 1200                                                G0025030
ISN       5           GO TO (216,214,212,218,222,224,226,228,230,232,234),L                     G0025040
                C                                                                               G0025050
                C  216 WRITE(6,217)IEMD                                                         G0025060
ISN       6           216 WRITE(6,217)I1                                                        G0025070
ISN       7           217 FORMAT('1',58('*'),/1X,'***  NO CONVERGENCE ON THE COMBINED P-T-S-  G0025080
                     1X ITERATION  ***',/1X,3('*'),14X,I2,'  ITERATIONS COMPLETED',15X,        G0025090
                     23('*'),/1X,58('*'))                                                       G0025100
ISN       8           GO TO 1191                                                                G0025110
                C  214 WRITE(6,215)ITMAX                                                        G0025120
ISN       9           214 WRITE(6,215)I1                                                        G0025130
ISN      10           215 FORMAT('1',58('*'),/1X,'***  NO CONVERGENCE ON PRESSURE-TEMPERATURG0025140
                     1E ITERATION  ***',/1X,3('*'),14X,I2,'  ITERATIONS COMPLETED',15X,        G0025150
                     23('*'),/1X,58('*'))                                                       G0025160
ISN      11           GO TO 1191                                                                G0025170
                C  212 WRITE(6,213)ITMAX                                                        G0025180
ISN      12           212 WRITE(6,213)I1                                                        G0025190
ISN      13           213 FORMAT('1',60('*'),/1X,'***  NO CONVERGENCE ON SATURATION-COMPOSITG0025200
                     1ION ITERATION  ***',/1X,3('*'),15X,I2,'  ITERATIONS COMPLETED',        G0025210
                     216X,3('*'),/1X,60('*'))                                                   G0025220
ISN      14           GO TO 1191                                                                G0025230
                C  218 WRITE(6,219)SMPDUM,SGPDUM,LCTN,IMRONG                                    G0025240
ISN      15           218 WRITE(6,219)R1,R2,I1,I2                                               G0025250
ISN      16           219 FORMAT('1',45('*'),/1X,'***  AN OUT-OF-RANGE ERROR HAS OCCURRED.    G0025260
                     1***',/1X,'***  SMP = ',G11.4,2X,'SGP = ',G11.4,2X,'***',/1X,            G0025270
                     2'***  PRGM LOCATION = ',I2,2X,'GRID POINT = ',I2,'  ***',/1X,           G0025280
                     345('*'))                                                                  G0025290
ISN      17           GO TO 1191                                                                G0025300
                C  222 WRITE(6,223)P(1),P(3)                                                    G0025310
ISN      18           222 WRITE(6,223)R1,R2                                                     G0025320
ISN      19           223 FORMAT('1',34('*'),/1X,'***  ABNORMAL PRESSURE AT I = 2  ***',     G0025330
                     1/1X,'***     P(1) = ',G13.6,'     ***',/1X,'***     P(3) = ',G13.6,    G0025340
                     2'     ***',/1X,34('*'))                                                  G0025350
ISN      20           GO TO 1191                                                                G0025360
                C  224 WRITE(6,225)DTEX,DT                                                      G0025370
ISN      21           224 WRITE(6,225)R1,R2                                                     G0025380
ISN      22           225 FORMAT('1',34('*'),/1X,'***  DTEX DOES NOT EQUAL DT  ***',         G0025390
                     1/1X,'***    DTEX = ',G13.6,'     ***',/1X,'***     DT  = ',G13.6,     G0025400
                     2'     ***',/1X,34('*'))                                                  G0025410
ISN      23           GO TO 1191                                                                G0025420
                C  226 WRITE(6,227)ITABL,LCTN                                                   G0025430
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                    *....*...1.........2.........3.........4.........5.........6.........7.*.......8

ISN        24       226 WRITE(6,227)I1,I2                                                          G0025440
ISN        25       227 FORMAT('1',34('*'),/' ***        THE ABSCISSA         ***',             G0025450
                      1 /1X,'***     IS OUTSIDE THE RANGE     ***',                              G0025460
                      2 /1X,'***          OF TABLE  ',I1,'     ***',                            G0025470
                      3 /1X,'***     AT PROGRAM LOCATION ',I2,'  ***',/1X,34('*'))               G0025480
ISN        26           GO TO 1191                                                                 G0025490
ISN        27       228 WRITE(6,229)                                                               G0025500
ISN        28       229 FORMAT('1',34('*'),/' *** SORRY, THE PROGRAM CAN NOT ***'/                 G0025510
                      1 1X,'***HANDLE PERCENTAGES BY WEIGHT***'/1X,34('*'))                      G0025520
ISN        29           GO TO 1191                                                                 G0025530
ISN        30       230 WRITE(6,231)                                                               G0025540
ISN        31       231 FORMAT('1',34('*'),/' *** THE SATS SUBROUTINE FAILED ***',                 G0025550
                      1 /1X,34('*'))                                                             G0025560
ISN        32           GO TO 1191                                                                 G0025570
ISN        33       232 WRITE(6,233)                                                               G0025580
ISN        34       233 FORMAT('1',34('*'),/' *** THE CONDITION NUMBER RCOND ***'/                 G0025590
                      1 1X,'***  IS CONSISTENTLY TOO SMALL.***'/1X,34('*'))                       G0025600
ISN        35           GO TO 1191                                                                 G0025610
                    C 234 WRITE(6,235)IWRONG,ITER,OTEMP,TEMP                                     G0025620
ISN        36         234 WRITE(6,235)I1,I2,R1,R2                                                G0025630
ISN        37         235 FORMAT('1',46('*'),                                                    G0025640
                      1 /1X,'***          THE EQUILIBRIUM TEMPERATURE      ***',                G0025650
                      2 /1X,'***            CALCULATION AT I=',I3,'          ***',              G0025660
                      3 /1X,'*** HAS NOT CONVERGED AFTER ',I2,' ITERATIONS. ***',                G0025670
                      4 /1X,'***     THE LAST TWO TEMPERATURE ITERATES    ***',                G0025680
                      5 /1X,'***          WERE ',F8.5,' AND ',F8.5,'          ***',/1X,46('*'))G0025690
                    C                                                                            G0025700
ISN        38       1191 CONTINUE                                                                G0025710
ISN        39           RETURN                                                                   G0025720
ISN        40       1200 CONTINUE                                                                G0025730
ISN        41           WRITE(6,1201)L                                                           G0025740
ISN        42       1201 FORMAT(' ******ERROR #',I3)                                             G0025750
                    C                                                                            G0025760
ISN        43           RETURN                                                                   G0025770
ISN        44           END                                                                      G0025780
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*STATISTICS*   SOURCE STATEMENTS = 44, PROGRAM SIZE = 3092 BYTES, PROGRAM NAME = ERRMSG    PAGE:   48.

*STATISTICS*    NO DIAGNOSTICS GENERATED.

**ERRMSG** END OF COMPILATION 5 ******
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OPTIONS IN EFFECT:  NOLIST NOMAP NOXREF NOGOSTMT NODECK   SOURCE   TERM NOOBJECT FIXED  NOTEST   TRMFLG   SRCFLG
                    NOSYM NORENT   SDUMP AUTODBL(NONE)   NOSXM   IL
                      OPT(0) LANGLVL(77) NOFIPS   FLAG(I)   NAME(MAIN  )  LINECOUNT(60)      CHARLEN(500)

                    *....*...1.........2.........3.........4.........5.........6.........7.*.......8

                    C.OUTPT1                                                                     G0025790
                    C                                                                            G0025800
                    C   S7.  OUTPUT OF RESERVOIR CONDITIONS , CUMULATIVE FLUXES , ETC.        G0025810
                    C                                                                            G0025820
ISN         1           SUBROUTINE OUTPT1(BDEBUG)                                                G0025830
ISN         2           IMPLICIT DOUBLE PRECISION (A-H,K,O-Z)                                    G0025840
                    C                                                                            G0025850
ISN         3           LOGICAL BDEBUG                                                           G0025860
                    C                                                                            G0025870
ISN         4           LOGICAL QEQUIL                                                           G0025880
ISN         5           LOGICAL COORTR,TRACKF,OVTAKE,DATAFR,RESTRT                               G0025890
ISN         6           DOUBLE PRECISION MOBGL,MOBML,MOBOL,MOBTL                                 G0025900
ISN         7           LOGICAL RCONDL                                                           G0025910
ISN         8           DOUBLE PRECISION MOBGR,MOBMR,MOBOR,MOBTR                                 G0025920
ISN         9           LOGICAL RCONDR                                                           G0025930
                    C                                                                            G0025940
ISN        10           COMMON/WRITE1/QDISTX(55),QP(55),QT(55),QSWP(55),QSOP(55),QSGP(55),G0025950
                    1                 QXMOLE(3,55),QYMOLE(4,55),                             G0025960
                    2                 QR(55),QQ(55),QV(55),TIME,STORDT,QAINJV,QPRODV,        G0025970
                    3                 QEQUIL(55),IJKLMN,IMAXN,IFIRST,IEND                    G0025980
ISN        11           COMMON/WRITE2/AMTINP(10),CUMINJ(11),CUMPRD(10),BALERR(10)                G0025990
ISN        12           COMMON/WRITE3/FLOTOT,FLOWAT,FLOOIL,FLOGAS,CUMENL,CUMWAT,CUMSVL,          G0026000
                    1                 CUMVOL,CUMINT,CUMENG,CUMSTM,CUMSVG,CUMVOG,CUMPVI,      G0026010
                    2                 PRDOIL,PRDWAT,PRDGAS                                   G0026020
ISN        13           COMMON/ISTAGE/ITIME,ITERAT                                               G0026030
ISN        14           COMMON/GRIPRO/DT,DXFRNT,DISXM,DX(57),DISTX(58),NFRONT,NBLOKS,            G0026040
                    1                 NG,NJAY,COORTR,TRACKF,OVTAKE,DATAFR,RESTRT             G0026050
ISN        15           COMMON/INJCND/RATEL,PSPECL,MOBGL,MOBML,MOBOL,MOBTL,                      G0026060
                    1                 AINJV,TSPECL,                                          G0026070
                    2                 RCONDL                                                 G0026080
ISN        16           COMMON/PRDCND/RATER,PSPECR,MOBGR,MOBMR,MOBOR,MOBTR,                      G0026090
                    1                 PRODV,TSPECR,                                          G0026100
                    2                 RCONDR                                                 G0026110
ISN        17           COMMON/IJTBIJ/IOFGRP(55),JOFGRP(55),JGRPIJ(36,24)                        G0026120
ISN        18           COMMON/OFRNCF/OFRNDS(36)                                                 G0026130
                    C                                                                            G0026140
ISN        19           IF (BDEBUG) WRITE(6,335)                                                 G0026150
ISN        21       335 FORMAT('0THIS IS FOR DEBUGGING')                                         G0026160
ISN        22           ISTEPS=ITIME-1                                                           G0026170
ISN        23           WRITE(6,341)TIME,ISTEPS,STORDT                                           G0026180
ISN        24       341 FORMAT(' ',/1X,' TIME = ',F12.1,' SECONDS ',  TOTAL NUMBER OF TIME G0026190
                    1STEPS = ',I6,' ',  LATEST TIME STEP SIZE = ',F11.3,' SECONDS ')          G0026200
ISN        25           WRITE(6,340)ITERAT                                                       G0026210
ISN        26       340 FORMAT(' NUMBER OF PRESS-TEMP-SAT-COMP ITERATIONS : ',I3)                G0026220
ISN        27           IF (BDEBUG) GO TO 485                                                    G0026230
ISN        28           L5=-7                                                                    G0026240
ISN        29       7547 L5=L5+8                                                                 G0026250
                    C       IN ORDER TO PRINT GROUP #1 BY ITSELF: (IF COORTR IS TRUE)            G0026260
ISN        30           IF (COORTR.AND.L5.EQ.9) L5=2                                             G0026270
ISN        32           L6=MIN0(L5+7,NJAY)                                                       G0026280
ISN        33           IF (COORTR.AND.L5.EQ.1) L6=1                                             G0026290
ISN        35           WRITE(6,342)(QDISTX(I),I=L5,L6)                                          G0026300
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                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
ISN       36    342   FORMAT('0',2X,'DISTX =',8(1X,G13.6))                                    G0026310
ISN       37          WRITE(6,5157)(QEQUIL(I),I=L5,L6)                                       G0026320
ISN       38    5157  FORMAT(' ',2X,'EQUIL =',8(L7,7X))                                      G0026330
ISN       39          WRITE(6,343)(OP(I),I=L5,L6)                                            G0026340
ISN       40    343   FORMAT(' ',6X,'P =',8(1X,G13.6))                                       G0026350
ISN       41          WRITE(6,344)(OT(I),I=L5,L6)                                            G0026360
ISN       42    344   FORMAT(' ',6X,'T =',8(1X,G13.6))                                       G0026370
ISN       43          WRITE(6,345)(OSMP(I),I=L5,L6)                                          G0026380
ISN       44    345   FORMAT(' ',4X,'SMP =',8(1X,G13.6))                                     G0026390
ISN       45          WRITE(6,346)(OSOP(I),I=L5,L6)                                          G0026400
ISN       46    346   FORMAT(' ',4X,'SOP =',8(1X,G13.6))                                     G0026410
ISN       47          WRITE(6,347)(OSGP(I),I=L5,L6)                                          G0026420
ISN       48    347   FORMAT(' ',4X,'SGP =',8(1X,G13.6))                                     G0026430
ISN       49          WRITE(6,348)(OXMOLE(1,I),I=L5,L6)                                      G0026440
ISN       50    348   FORMAT(' ',5X,'XO =',8(1X,G13.6))                                      G0026450
ISN       51          WRITE(6,349)(OXMOLE(3,I),I=L5,L6)                                      G0026460
ISN       52    349   FORMAT(' ',5X,'XN =',8(1X,G13.6))                                      G0026470
ISN       53          WRITE(6,352)(OXMOLE(2,I),I=L5,L6)                                      G0026480
ISN       54    352   FORMAT(' ',3X,'XSOL =',8(1X,G13.6))                                    G0026490
ISN       55          WRITE(6,353)(OYMOLE(4,I),I=L5,L6)                                      G0026500
ISN       56    353   FORMAT(' ',5X,'YS =',8(1X,G13.6))                                      G0026510
ISN       57          WRITE(6,354)(OYMOLE(1,I),I=L5,L6)                                      G0026520
ISN       58    354   FORMAT(' ',5X,'YO =',8(1X,G13.6))                                      G0026530
ISN       59          WRITE(6,355)(OYMOLE(2,I),I=L5,L6)                                      G0026540
ISN       60    355   FORMAT(' ',5X,'YV =',8(1X,G13.6))                                      G0026550
ISN       61          IF (COORTR.AND.L6.GT.1) WRITE(6,5155)(OFRNDS(IOFGRP(I)),I=L5,L6)       G0026560
ISN       63     5155 FORMAT(' ',1X,'FRNDIS =',8(1X,G13.6))                                  G0026570
ISN       64          IF (NJAY.GT.L6+7) GO TO 7547                                           G0026580
ISN       65          WRITE(6,12321)DAINJV,FLOWAT,FLOOIL,FLOGAS                              G0026590
ISN       66    12321 FORMAT('0','TOTAL VOLUMETRIC FLUX AT FRACTURE FACE = ',G13.6,          G0026600
                1' M/S',/,1X,'PHASE FLOW FRACTIONS ARE :   WATER = ',F8.4,',  OIL =        G0026610
                2' ,F8.4,',  GAS = ',F8.4)                                                  G0026620
ISN       67          WRITE(6,357)                                                           G0026630
ISN       68          WRITE(6,12322)OPRODV                                                   G0026640
ISN       69    12322 FORMAT('0TOTAL VOLUMETRIC FLUX AT THE OTHER SIDE= ',G13.6,' M/S')     G0026650
ISN       70    357   FORMAT('0','CUMULATIVE FLUXES AT FRACTURE FACE (KGMOL/SQ.M.) :')       G0026660
ISN       71      359 FORMAT('0',                                                            G0026670
                1  40X,'      AMOUNT-      CUMULATIVE      CUMULATIVE      MASS/ENERGY '/G0026680
                2  40X,'  IN-PLACE       INJECTION       PRODUCTION     BALANCE ERROR'/G0026690
                3  40X,'  (KGMOL)          (KGMOL/SQ.M.)                    (%)     ')  G0026700
ISN       72      360 FORMAT(20X,'LIQUID    ENERGY   ',G15.8,2(2X,G13.6),3X,G13.6/       G0026710
                1       20X,'             WATER    ',G15.8,2(2X,G13.6),3X,G13.6/       G0026720
                2       20X,'           SOLVENT    ',G15.8,2(2X,G13.6),3X,G13.6/       G0026730
                3       20X,'         LIGHT OIL    ',G15.8,2(2X,G13.6),3X,G13.6/       G0026740
                4       20X,'         HEAVY OIL    ',G15.8,2(2X,G13.6),3X,G13.6 )      G0026750
ISN       73      361 FORMAT(20X,'VAPOUR    ENERGY   ',G15.8,2(2X,G13.6)/               G0026760
                1       20X,'             STEAM    ',G15.8,2(2X,G13.6)/                G0026770
                2       20X,'           SOLVENT    ',G15.8,2(2X,G13.6)/                G0026780
                3       20X,'         LIGHT OIL    ',G15.8,2(2X,G13.6) )               G0026790
ISN       74      485 CONTINUE                                                           G0026800
ISN       75          WRITE(6,359)                                                       G0026810
ISN       76          WRITE(6,360)(AMTINP(I),CUMINJ(I),CUMPRD(I),BALERR(I),I=1,5)        G0026820
ISN       77          WRITE(6,361)(AMTINP(I),CUMINJ(I),CUMPRD(I),I=6,9)                  G0026830
ISN       78          RETURN                                                             G0026840
ISN       79          END                                                                G0026850
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*STATISTICS*   SOURCE STATEMENTS = 75, PROGRAM SIZE = 6376 BYTES, PROGRAM NAME = OUTPT1    PAGE:  50.
*STATISTICS*    NO DIAGNOSTICS GENERATED.
**OUTPT1** END OF COMPILATION 6 ******
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OPTIONS IN EFFECT:  NOLIST NOMAP NOXREF NOGOSTMT NODECK   SOURCE   TERM NOOBJECT FIXED  NOTEST   TRMFLG   SRCFLG
                    NOSYM NORENT   SDUMP AUTODBL(NONE)   NOSXM    IL
                      OPT(0) LANGLVL(77) NOFIPS   FLAG(I)  NAME(MAIN  )  LINECOUNT(60)      CHARLEN(500)

                  *....*...1.........2.........3.........4.........5.........6.........7.*.......8

                  C.PERMS                                                                          G0026860
                  C                                                                                G0026870
                  C                                                                                G0026880
                  C     S8.  CALCULATION OF RELATIVE PERMEABILITIES                                G0026890
                  C
ISN         1           SUBROUTINE PERMS(IPARM,CALDRV)                                           G0026900
ISN         2           IMPLICIT DOUBLE PRECISION (A-H,K,O-Z)                                    G0026910
                  C                                                                                G0026920
ISN         3           LOGICAL CALDRV                                                           G0026930
                  C                                                                                G0026940
                  C                                                                                G0026950
ISN         4           COMMON/PRMBLK/SWC,SOIRR,SGIRR,SGPDUM,SMPDUM,KRGDUM,KROG,KROW,            G0026960
                     !                KRWDUM,KRODUM,KRGSGD,KROGSG,KROMSW,KRMSWD,KROSGD,        G0026970
                     2                KROSWD,PCWDUM,PCVDUM,                                    G0026980
                     3                LCTN,IERR,IWRONG                                         G0026990
ISN         5           COMMON/TABLE3/TABSW(16),TABKRW(16),TABKOW(16),TABPCW(16),                G0027000
                     !                IENTSW(55),NENTSW                                        G0027010
ISN         6           COMMON/TABLE4/TABSL(18),TABKRG(18),TABKOG(18),TABPCV(18),                G0027020
                     !                IENTSL(55),NENTSL                                        G0027030
ISN         7           COMMON/ERRORT/ITABL                                                      G0027040
                  C                                                                                G0027050
ISN         8           I=IPARM                                                                  G0027060
ISN         9       130 CONTINUE                                                                 G0027070
                  C     ITABL=3  HAS MOVED.                                                        G0027080
ISN        10           IF (SMPDUM.GE.TABSW(IENTSW(I))) GO TO 135                                G0027090
ISN        11           IENTSW(I)=IENTSW(I)-1                                                    G0027100
ISN        12           IF (IENTSW(I).LE.0) THEN                                                 G0027110
ISN        13              IERR=I                                                                G0027120
ISN        14              IWRONG=I                                                              G0027130
ISN        15              ITABL=3                                                               G0027140
ISN        16              CALL ERRMSG(7,ITABL,LCTN,ZERO,ZERO)                                   G0027150
                  C                 I.E. CALL ERRMSG(L,I1,I2,R1,R2)                            G0027160
ISN        17              RETURN                                                                G0027170
ISN        18           END IF                                                                   G0027180
ISN        19           GO TO 130                                                                G0027190
ISN        20       135 CONTINUE                                                                 G0027200
ISN        21           IF (SMPDUM.LE.TABSW(IENTSW(I)+1)) GO TO 140                              G0027210
ISN        22           IENTSW(I)=IENTSW(I)+1                                                    G0027220
ISN        23           IF (IENTSW(I).GE.NENTSW) THEN                                            G0027230
ISN        24              IERR=I                                                                G0027240
ISN        25              IWRONG=I                                                              G0027250
ISN        26              ITABL=3                                                               G0027260
ISN        27              CALL ERRMSG(7,ITABL,LCTN,ZERO,ZERO)                                   G0027270
                  C                 I.E. CALL ERRMSG(L,I1,I2,R1,R2)                            G0027280
ISN        28              RETURN                                                                G0027290
ISN        29           END IF                                                                   G0027300
ISN        30           GO TO 135                                                                G0027310
ISN        31       140 CONTINUE                                                                 G0027320
                  C     ITABL=4  HAS MOVED.                                                        G0027330
ISN        32           SLDUM=1.000-SGPDUM                                                       G0027340
ISN        33           IF (SLDUM.GE.TABSL(IENTSL(I))) GO TO 145                                 G0027350
ISN        34           IENTSL(I)=IENTSL(I)-1                                                    G0027360
ISN        35           IF (IENTSL(I).LE.0) THEN                                                 G0027370
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                  *....*...1.........2.........3.........4.........5.........6.........7.*.......8

ISN        36              IERR=I                                                                G0027380
ISN        37              IWRONG=I                                                              G0027390
ISN        38              ITABL=4                                                               G0027400
ISN        39              CALL ERRMSG(7,ITABL,LCTN,ZERO,ZERO)                                   G0027410
                  C                 I.E. CALL ERRMSG(L,I1,I2,R1,R2)                            G0027420
ISN        40              RETURN                                                                G0027430
ISN        41           END IF                                                                   G0027440
ISN        42           GO TO 140                                                                G0027450
ISN        43       145 CONTINUE                                                                 G0027460
ISN        44           IF (SLDUM.LE.TABSL(IENTSL(I)+1)) GO TO 150                               G0027470
ISN        45           IENTSL(I)=IENTSL(I)+1                                                    G0027480
ISN        46           IF (IENTSL(I).GE.NENTSL) THEN                                            G0027490
ISN        47              IERR=I                                                                G0027500
ISN        48              IWRONG=I                                                              G0027510
ISN        49              ITABL=4                                                               G0027520
ISN        50              CALL ERRMSG(7,ITABL,LCTN,ZERO,ZERO)                                   G0027530
                  C                 I.E. CALL ERRMSG(L,I1,I2,R1,R2)                            G0027540
ISN        51              RETURN                                                                G0027550
ISN        52           END IF                                                                   G0027560
ISN        53           GO TO 145                                                                G0027570
ISN        54       150 CONTINUE                                                                 G0027580
                  C     ITABL=0  HAS DELETED.                                                      G0027590
ISN        55           IF (SGPDUM.LT.-1.D-5.OR.SGPDUM.GT.1.D0) IERR=I                           G0027600
ISN        57           IE=IENTSL(I)                                                             G0027610
ISN        58           KROG = TABKOG(IE) + (TABKOG(IE+1)-TABKOG(IE))                            G0027620
                     !                   *(SLDUM-TABSL(IE))/(TABSL(IE+1)-TABSL(IE))            G0027630
ISN        59           KRGDUM = TABKRG(IE) + (TABKRG(IE+1)-TABKRG(IE))                          G0027640
                     !                   *(SLDUM-TABSL(IE))/(TABSL(IE+1)-TABSL(IE))            G0027650
ISN        60           PCVDUM = TABPCV(IE) + (TABPCV(IE+1)-TABPCV(IE))                          G0027660
                     !                   *(SLDUM-TABSL(IE))/(TABSL(IE+1)-TABSL(IE))            G0027670
ISN        61           IE=IENTSW(I)                                                             G0027680
ISN        62           KROW   = TABKOW(IE) + (TABKOW(IE+1)-TABKOW(IE))                          G0027690
                     !                   *(SMPDUM-TABSW(IE))/(TABSW(IE+1)-TABSW(IE))           G0027700
ISN        63           KRWDUM = TABKRW(IE) + (TABKRW(IE+1)-TABKRW(IE))                          G0027710
                     !                   *(SMPDUM-TABSW(IE))/(TABSW(IE+1)-TABSW(IE))           G0027720
ISN        64           PCWDUM = TABPCW(IE) + (TABPCW(IE+1)-TABPCW(IE))                          G0027730
                     !                   *(SMPDUM-TABSW(IE))/(TABSW(IE+1)-TABSW(IE))           G0027740
ISN        65           KRODUM = (KROW+KRWDUM)*(KROG+KRGDUM)-KRWDUM-KRGDUM                       G0027750
ISN        66           IF (KRODUM.LT.0.D0) KRODUM=0.D0                                          G0027760
ISN        68           IF (.NOT.CALDRV) RETURN                                                  G0027770
ISN        70           IE=IENTSL(I)                                                             G0027780
ISN        71           KROGSG=-(TABKOG(IE+1)-TABKOG(IE))/(TABSL(IE+1)-TABSL(IE))                G0027790
ISN        72           IF (KROG.LE.0.D0) KROGSG=0.D0                                            G0027800
ISN        74           KRGSGD=-(TABKRG(IE+1)-TABKRG(IE))/(TABSL(IE+1)-TABSL(IE))                G0027810
ISN        75           IF (KRGDUM.GE.1.D0) KRGSGD=0.D0                                          G0027820
ISN        77           IE=IENTSW(I)                                                             G0027830
ISN        78           KROMSW= (TABKOW(IE+1)-TABKOW(IE))/(TABSW(IE+1)-TABSW(IE))                G0027840
ISN        79           KRMSWD= (TABKRW(IE+1)-TABKRW(IE))/(TABSW(IE+1)-TABSW(IE))                G0027850
ISN        80           KROSWD=(KROG+KRGDUM)*(KROMSW+KRMSWD)-KRMSWD                              G0027860
ISN        81           IF (KRODUM.LE.0.D0) KROSWD=0.D0                                          G0027870
ISN        83           KROSGD=(KROW+KRWDUM)*(KROGSG+KRGSGD)-KRGSGD                              G0027880
ISN        84           IF (KRODUM.LE.0.D0) KROSGD=0.D0                                          G0027890
ISN        86           RETURN                                                                   G0027900
ISN        87           END                                                                      G0027910

*STATISTICS*   SOURCE STATEMENTS = 80, PROGRAM SIZE = 4048 BYTES, PROGRAM NAME = PERMS    PAGE:  53.
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STATISTICS NO DIAGNOSTICS GENERATED.

PERMS END OF COMPILATION 7 ******

OPTIONS IN EFFECT: NOLIST NOMAP NOXREF NOGOSTMT NODECK SOURCE TERM NOOBJECT FIXED NOTEST TRMFLG SRCFLG
NOSYM NORENT SDUMP AUTODBL(NONE) NOSXM IL
OPT(0) LANGLVL(77) NOFIPS FLAG(I) NAME(MAIN) LINECOUNT(60) CHARLEN(500)

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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
                C.TEMPS                                                                          G0027920
                C                                                                                G0027930
                C   S9.  ITERATIVE CALCULATION OF TEMPERATURE GIVEN P & COMPOSITION             G0027940
                C                                                                                G0027950
ISN         1         SUBROUTINE TEMPS(IPARM,NORMAL,LCTN,IERR,IWRONG)                            G0027960
ISN         2         IMPLICIT DOUBLE PRECISION (A-H,K,O-Z)                                      G0027970
                C                                                                                G0027980
ISN         3         LOGICAL NORMAL                                                             G0027990
ISN         4         DOUBLE PRECISION MRATIO                                                    G0028000
                C                                                                                G0028010
ISN         5         DOUBLE PRECISION MO,MWOIL,MSOL,MGP                                         G0028020
                C                                                                                G0028030
ISN         6         COMMON/PVAPOR/PWAT(55),POIL(55),PSOL(55),DPWAT(55),DPOIL(55),              G0028040
                1                 DPSOL(55),DPDT(55),YMOLE(4,55),YO(55),YW(55),YS(55)            G0028050
ISN         7         COMMON/VPCONS/AW,BW,AO,BO,CO,ASOL,BSOL,CSOL,†O(55)                         G0028060
ISN         8         COMMON/STATEV/SWP(55),SGP(55),SOP(55),†(55),P(55),                         G0028070
                1                 XMOLE(3,55),XO(55),XSOL(55),XW(55)                             G0028080
ISN         9         COMMON/MWEITS/MO,MWOIL,MSOL,MGP,RTMWAT,RTMOIL,RTMINT,RTMSOL                G0028090
ISN        10         COMMON/LNHOLD/XLOG10                                                       G0028100
ISN        11         COMMON/TABLE1/TACTEM(12),TALMUO(12),TALMUM(12),TAMMUG(12),                 G0028110
                1                 IENTTI(55),NENTTI                                              G0028120
ISN        12         COMMON/TABLE2/TABXM(8),TABUOR(8),IENTXN(55),NENTXN                         G0028130
ISN        13         COMMON/TABLE3/TABSM(16),TABKRM(16),TABKOM(16),TABPCM(16),                  G0028140
                1                 IENTSM(55),NENTSM                                              G0028150
ISN        14         COMMON/TABLE4/TABSL(18),TABKRG(18),TABKOG(18),TABPCV(18),                  G0028160
                1                 IENTSL(55),NENTSL                                              G0028170
ISN        15         COMMON/TABLE5/STMTAB(20,6),IENTT2(55),NENTT2                               G0028180
ISN        16         COMMON/ERRORT/ITABL                                                        G0028190
ISN        17         COMMON/BASICS/ZERO,HALF,ONE,TWO                                            G0028200
ISN        18         COMMON/MAXES /NGRPMX                                                       G0028210
                C                                                                                G0028220
ISN        19         I=IPARM                                                                    G0028230
ISN        20         TEMP=T(I)                                                                  G0028240
ISN        21         ICHECK=1                                                                   G0028250
ISN        22         IF (.NOT.NORMAL) WRITE(6,101)ICHECK,I,TEMP                                 G0028260
                C                                                                                G0028270
ISN        24         MRATIO=MO/MWOIL                                                            G0028280
ISN        25         EO=0.01D0                                                                  G0028290
ISN        26         FEO=1.0D6/(XLOG10*EO)                                                      G0028300
ISN        27         XMOL1I=XMOLE(1,I)                                                          G0028310
ISN        28         FMSML=MRATIO/(ONE-XMOL1I+(XMOL1I*MRATIO))                                  G0028320
ISN        29         XMAS1I=XMOL1I*FMSML                                                        G0028330
                C                                                                                G0028340
ISN        30         ITER=0                                                                     G0028350
ISN        31    9428 CONTINUE                                                                   G0028360
                C                                                                                G0028370
ISN        32         CALL TABENT(I,I,LCTN,NGRPMX,12,8,16,18,20,                                 G0028380
                1                 .FALSE.,NENTTI,TACTEM,TALMUO,TALMUM,TAMMUG,IENTTI,           G0028390
                2                 .FALSE.,NENTXN,TABXM ,TABUOR,                IENTXN,         G0028400
                3                 .FALSE.,NENTSM,TABSM ,TABKRM,TABKOM,TABPCM,IENTSM,           G0028410
                4                 .FALSE.,NENTSL,TABSL ,TABKRG,TABKOG,TABPCV,IENTSL,           G0028420
                5                 .TRUE. ,NENTT2,STMTAB                       ,IENTT2,         G0028430
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                    *....*...1.....2.....3.....4.....5.....6.....7.*.....8
                       6              ITABL,IERR,IHRONG)                                  G0028440
                     C          I.E. CALL SUBROUTINE TABENT(ISTART,IFINIS,LCTN,NGRPMX,   G0028450
                     C                                  NMXTI,NMXXN,NMXSM,NMXSL,NMXT2,    G0028460
                     C                                  LTI,NENTTI,TACTEM,TALMUO,TALMUM,TAMMUG,IENTTI,  G0028470
                     C                                  LXN,NENTXN,TABXN ,TABUOR,                 IENTXN,  G0028480
                     C                                  LSM,NENTSM,TABSM ,TABKRM,TABKOM,TABPCM,IENTSM,  G0028490
                     C                                  LSL,NENTSL,TABSL ,TABKRG,TABKOG,TABPCV,IENTSL,  G0028500
                     C                                  LT2,NENTT2,STMTAB                   ,IENTT2,  G0028510
                     C                                  ITABL,IERR,IHRONG)                  G0028520
ISN        33          IF (ITABL.NE.0) RETURN                                             G0028530
                     C                                                                     G0028540
ISN        35          OTEMP=TEMP                                                         G0028550
ISN        36          IE=IENTT2(I)                                                       G0028560
ISN        37          TI=TEMP                                                            G0028570
ISN        38            TFAC= (TI-STMTAB(IE,1)) /(STMTAB(IE+1,1)-STMTAB(IE,1))          G0028580
ISN        39          PHATI=STMTAB(IE,2)+(STMTAB(IE+1,2)-STMTAB(IE,2))*TFAC              G0028590
ISN        40          PSOLI=ASOL*DEXP(-XLOG10*BSOL/(CSOL+TEMP))                          G0028600
ISN        41            P1I= AO *DEXP(-XLOG10* BO /( CO +TEMP))                          G0028610
ISN        42          G2=P1I*XMAS1I/FEO                                                  G0028620
                     C        SOLVE  PSTAR*DEXP(-PSTAR) = G2  , WHERE PSTAR = P/FEO .     G0028630
ISN        43          PPOILI=FEO*G2*(ONE+G2*(ONE+G2*(1.5D0+G2*2.667D0)))                 G0028640
                     C                                  2     3     4                     G0028650
                     C             I.E.   FEO * ( G2 + G2  + 1.5*G2  + 2.667*G2  )      G0028660
ISN        44          FUNCTN=PHATI+PPOILI+XMOLE(2,I)*PSOLI-P(I)                          G0028670
ISN        45          DPHATI=(STMTAB(IE+1,2)-STMTAB(IE,2))/(STMTAB(IE+1,1)-STMTAB(IE,1))G0028680
ISN        46          DPSOLI=PSOLI*BSOL*XLOG10/(CSOL+TEMP)**2                            G0028690
ISN        47            DP1I=  P1I* BO *XLOG10/( CO +TEMP)**2                            G0028700
ISN        48          DG2DT=DP1I*XMAS1I/FEO                                              G0028710
ISN        49          DPPOIL=DG2DT*FEO*(ONE+G2*(TWO+G2*(4.5D0+G2*10.667D0)))             G0028720
                     C                                        2      3                    G0028730
                     C             I.E.   DG2DT*FEO * (1.0 + 2.0*G2 + 4.5*G2  + 10.667*G2  )  G0028740
ISN        50          DERIV=DPHATI+DPPOIL+XMOLE(2,I)*DPSOLI                              G0028750
ISN        51          TEMP=OTEMP-FUNCTN/DERIV                                            G0028760
ISN        52          TEST=DABS(TEMP-OTEMP)/(OTEMP+273.15D0)*100.D0                      G0028770
ISN        53          T(I)=TEMP                                                          G0028780
                     C   IF (TEST.GT.5.000)                                               G0028790
                     C  1 T(I)=AMAX1((OTEMP-13.7D0),AMIN1(T(I),(OTEMP+16.3D0)))         G0028800
                     C             I.E. IF TEST > 5.0, THEN OTEMP-13.7 <= T(I) <= OTEMP+16.3 .  G0028810
ISN        54          ITER=ITER+1                                                        G0028820
ISN        55          IF (ITER.GT.50) THEN                                               G0028830
ISN        56            IERR=1                                                           G0028840
ISN        57            IHRONG=I                                                         G0028850
ISN        58            CALL ERRMSG(11,IHRONG,ITER,OTEMP,TEMP)                           G0028860
                     C             I.E. CALL SUBROUTINE ERRMSG(L,I1,I2,R1,R2)           G0028870
ISN        59            RETURN                                                           G0028880
ISN        60          END IF                                                             G0028890
ISN        61          IF (TEST.GT.1.0D-11) GO TO 9428                                    G0028900
ISN        62      101 FORMAT(1X,'TEMPS CALLED AT CHECKPOINT ',I2,'  T(',I2,')=',F8.3)    G0028910
ISN        63          ICHECK=2                                                           G0028920
ISN        64          IF (.NOT.NORMAL) WRITE(6,101)ICHECK,I,TEMP                         G0028930
ISN        66          RETURN                                                             G0028940
ISN        67          END                                                                G0028950

*STATISTICS*   SOURCE STATEMENTS = 64, PROGRAM SIZE = 4656 BYTES, PROGRAM NAME = TEMPS    PAGE:  56.

*STATISTICS*    NO DIAGNOSTICS GENERATED.
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**TEMPS** END OF COMPILATION 8 ******
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OPTIONS IN EFFECT:  NOLIST NOMAP NOXREF NOGOSTMT NODECK   SOURCE   TERM NOOBJECT FIXED  NOTEST   TRMFLG   SRCFLG
                    NOSYM NORENT   SDUMP AUTODBL(NONE)   NOSXM   IL
                      OPT(0) LANGLVL(77) NOFIPS   FLAG(I)  NAME(MAIN  ) LINECOUNT(60)      CHARLEN(500)

                 *....*...1.....2.....3.....4.....5.....6.....7.*.....8
                      C.VPTEMP                                                                  G0028960
                      CCCC                                                                      G0028970
                        S9.  ITERATIVE CALCULATION OF TEMPERATURE GIVEN P & COMPOSITION         G0028980
ISN         1             SUBROUTINE VPTEMP(IPARM,NORMAL,TCHNGE,DERIVS,LHALF,                   G0028990
                     1                    LCTN,NGRPMX,P,XMOLE,                                  G0029000
                     2                    PEQUIL,T,PHAT,POIL,PSOL,                              G0029010
                     3                    DPHAT,DPOIL,DPSOL,IERR,IWRONG)                        G0029020
ISN         2             IMPLICIT DOUBLE PRECISION (A-H,K,O-Z)                                 G0029030
                      C      NORMAL: IF  TRUE, THEN EMPHASIZE SPEED.                            G0029040
                      C              IF FALSE, THEN EMPHASIZE RELIABILITY AND DIAGNOSTICS.      G0029050
                      C      TCHNGE: IF  TRUE, THEN ITERATE AND DETERMINE THE TEMPERATURE.      G0029060
                      C              IF FALSE, THEN CALCULATE VAPOUR PRESSURES AND PEQUIL       G0029070
                      C                        "ONCE-THROUGH".                                  G0029080
                      C                        DO NOT ITERATE, DO NOT CHANGE THE TEMPERATURE    G0029090
                      C      DERIVS: IF  TRUE, THEN CALCULATE THE DERIVATIVES.                  G0029100
                      C              IF FALSE, THEN DO NOT CALCULATE THE DERIVATIVES.           G0029110
                      C                        DERIVS SHOULD BE  TRUE IF TCHNGE IS TRUE.        G0029120
                      C      LHALF : IF  TRUE, THEN CALCULATE VAPOUR PRESSURES HALFWAY          G0029130
                      C                        BETWEEN GRID POINTS.                             G0029140
                      C              IF FALSE, THEN DO THE CALCULATIONS AT THE GRID POINTS.     G0029150
                      C              LHALF  SHOULD BE FALSE IF TCHNGE IS TRUE.                  G0029160
                      C      TOHOLD: (THE HIDDEN PARAMETER -- HIDDEN IN A COMMON BLOCK)         G0029170
                      C              IF  TRUE, THEN SET T(I) EQUAL TO TO(I) BEFORE STARTING     G0029180
                      C                        THE ITERATION.  THIS TRICK REMOVES NOISE FROM    G0029190
                      C                        THE JACOBIAN CALCULATION.                        G0029200
                      C              IF FALSE, USE THE MOST RECENT VALUE OF T(I) FOR            G0029210
                      C                        WHATEVER CALCULATIONS WERE SPECIFIED BY THE      G0029220
                      C                        OTHER PARAMETERS.                                G0029230
                      C         (MY DECISION TO PLACE TOHOLD INTO A COMMON BLOCK                G0029240
                      C        BREAKS THE RULE THAT THE LOGICAL VARIABLES WHICH CONTROL         G0029250
                      C        A SUBROUTINE SHOULD BE PARAMETERS OF THE SUBROUTINE.             G0029260
                      C        HOWEVER, THE COMMON BLOCK METHOD APPEARS TO BE                   G0029270
                      C        THE 'CLEANEST' WAY TO ADD THE "TO CHANGE" TO THE PROGRAM.)       G0029280
                      C                                                                         G0029290
ISN         3             LOGICAL NORMAL,TCHNGE,DERIVS,LHALF                                    G0029300
ISN         4             DOUBLE PRECISION P(NGRPMX),T(NGRPMX),XMOLE(3,NGRPMX)                  G0029310
ISN         5             DOUBLE PRECISION PHAT(NGRPMX),POIL(NGRPMX),PSOL(NGRPMX)               G0029320
ISN         6             DOUBLE PRECISION DPHAT(NGRPMX),DPOIL(NGRPMX),DPSOL(NGRPMX)            G0029330
ISN         7             DOUBLE PRECISION WRATIO                                               G0029340
                      C                                                                         G0029350
ISN         8             LOGICAL TOHOLD                                                        G0029360
ISN         9             DOUBLE PRECISION WO,WWOIL,WSOL,WGP                                    G0029370
                      C                                                                         G0029380
ISN        10             COMMON/VPCONS/AM,BM,AO,BO,CO,ASOL,BSOL,CSOL,TO(55)                    G0029390
ISN        11             COMMON/VPLCOM/TOHOLD                                                  G0029400
ISN        12             COMMON/WWEITS/WO,WWOIL,WSOL,WGP,RTWWAT,RTWOIL,RTWINT,RTWSOL           G0029410
ISN        13             COMMON/LWHOLD/XLOG10                                                  G0029420
ISN        14             COMMON/TABLE1/TACTEM(12),TALMUO(12),TALMUM(12),TAMMUG(12),            G0029430
                     1                IENTTI(55),NENTTI                                        G0029440
ISN        15             COMMON/TABLE2/TABXN(8),TABUOR(8),IENTXN(55),NENTXN                    G0029450
ISN        16             COMMON/TABLE3/TABSN(16),TABKRM(16),TABKOM(16),TABPCM(16),             G0029460
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                 *....*...1.....2.....3.....4.....5.....6.....7.*.....8
                     1                IENTSM(55),NENTSM
ISN        17             COMMON/TABLE4/TABSL(18),TABKRG(18),TABKOG(18),TABPCV(18),             G0029480
                     1                IENTSL(55),NENTSL                                        G0029490
ISN        18             COMMON/TABLE5/STMTAB(20,6),IENTT2(55),NENTT2                          G0029500
ISN        19             COMMON/ERRORT/ITABL                                                   G0029510
ISN        20             COMMON/BASICS/ZERO,HALF,ONE,TWO                                       G0029520
                      C                                                                         G0029530
ISN        21             IF (TCHNGE.AND..NOT.DERIVS) WRITE(6,101)                              G0029540
ISN        23             I=IPARM                                                               G0029550
                      C        IF NEITHER TCHNGE NOR LHALF IS TRUE, THEN TEMP=T(I).             G0029560
ISN        24             TEMP=T(I)                                                             G0029570
ISN        25             IF (LHALF) TEMP=HALF*(T(I)+T(I+1))                                    G0029580
                      C        IF TCHNGE IS TRUE, THEN TEMP DEPENDS ON THE                    G0029590
                      C        HIDDEN PARAMETER TOHOLD (SEE COMMENTS 4.34/4.45).              G0029600
ISN        27             IF (TCHNGE.AND.TOHOLD) TEMP=TO(I)                                     G0029610
                      C        IF TCHNGE AND LHALF ARE BOTH TRUE, AN ERROR MESSAGE IS PRINTED.  G0029620
ISN        29             IF (TCHNGE.AND.LHALF) WRITE(6,102)                                    G0029630
ISN        31             ICHECK=1                                                              G0029640
ISN        32             IF (.NOT.NORMAL) WRITE(6,103)ICHECK,I,T(I),TEMP                       G0029650
                      C                                                                         G0029660
ISN        34             WRATIO=WO/WWOIL                                                       G0029670
ISN        35             EO=0.01DO                                                             G0029680
ISN        36             FEO=1.0D6/(XLOG10*EO)                                                 G0029690
ISN        37             XMOL1I=XMOLE(1,I)                                                     G0029700
ISN        38             FNSML=WRATIO/(ONE-XMOL1I+(XMOL1I*WRATIO))                             G0029710
ISN        39             XMAS1I=XMOL1I*FNSML                                                   G0029720
                      C                                                                         G0029730
ISN        40             ITER=0                                                                G0029740
ISN        41         50  CONTINUE                                                             G0029750
                      C                                                                         G0029760
ISN        42             CALL TABENT(I,I,LCTN,NGRPMX,12,8,16,18,20,                            G0029770
                     1                .FALSE.,NENTTI,TACTEM,TALMUO,TALMUM,TAMMUG,IENTTI,        G0029780
                     2                .FALSE.,NENTXN,TABXN ,TABUOR,       ,IENTXN,           G0029790
                     3                .FALSE.,NENTSM,TABSN ,TABKRM,TABKOM,TABPCM,IENTSM,        G0029800
                     4                .FALSE.,NENTSL,TABSL ,TABKRG,TABKOG,TABPCV,IENTSL,        G0029810
                     5                .TRUE. ,NENTT2,STMTAB,      ,       ,      ,IENTT2,       G0029820
                     6                ITABL,IERR,IWRONG)                                       G0029830
                      C        I.E. CALL SUBROUTINE TABENT(ISTART,IFINIS,LCTN,NGRPMX,           G0029840
                      C                  MMXTI,MMXXN,MMXSM,MMXSL,MMXT2,                        G0029850
                      C                  LTI,NENTTI,TACTEM,TALMUO,TALMUM,TAMMUG,IENTTI,        G0029860
                      C                  LXN,NENTXN,TABXN ,TABUOR,      ,IENTXN,               G0029870
                      C                  LSM,NENTSM,TABSN ,TABKRM,TABKOM,TABPCM,IENTSM,        G0029880
                      C                  LSL,NENTSL,TABSL ,TABKRG,TABKOG,TABPCV,IENTSL,        G0029890
                      C                  LT2,NENTT2,STMTAB,      ,      ,      ,IENTT2,        G0029900
                      C                  ITABL,IERR,IWRONG)                                    G0029910
ISN        43             IF (ITABL.NE.0) RETURN                                                G0029920
                      C                                                                         G0029930
ISN        45             QTEMP=TEMP                                                            G0029940
ISN        46             IE=IENTT2(I)                                                          G0029950
ISN        47             TI=TEMP                                                               G0029960
ISN        48               TFAC= (TI-STMTAB(IE,1)) /(STMTAB(IE+1,1)-STMTAB(IE,1))             G0029970
ISN        49             PHATI=STMTAB(IE,2)+(STMTAB(IE+1,2)-STMTAB(IE,2))*TFAC                 G0029980
ISN        50             PSOLI=ASOL*DEXP(-XLOG10*BSOL/(CSOL+TEMP))                             G0029990
ISN        51               P1I= AO *DEXP(-XLOG10* BO /( CO +TEMP))                             G0030000
ISN        52             G2=P1I*XMAS1I/FEO                                                     G0030010
                      C        SOLVE  PSTAR*DEXP(-PSTAR) = G2 , WHERE PSTAR = P/FEO .         G0030020
                                                                                                G0030030
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                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
ISN       53          PPOILI=FEO*G2*(ONE+G2*(ONE+G2*(1.5D0+G2*2.667D0)))                    G0030040
                                          2      3      4
C                                                                                          G0030050
C             I.E.   FEO * ( G2 + G2   + 1.5*G2   + 2.667*G2   )                          G0030060
ISN       54          IF (    (XMOL1I.GT.ZERO)) POILI=PPOILI/XMOL1I                        G0030070
ISN       56          IF (.NOT.(XMOL1I.GT.ZERO)) POILI=FMSML*P1I                           G0030080
ISN       58          PEQUIL=PMATI+PPOILI+XMOLE(2,I)*PSOLI                                 G0030090
ISN       59          FUNCTN=PEQUIL-P(I)                                                   G0030100
ISN       60          IF (.NOT.TCHNGE.AND..NOT.DERIVS) GO TO 90                            G0030110
ISN       61          DPMATI=(STMTAB(IE+1,2)-STMTAB(IE,2))/(STMTAB(IE+1,1)-STMTAB(IE,1))G0030120
ISN       62          DPSOLI=PSOLI*BSOL*XLOG10/(CSOL+TEMP)**2                              G0030130
ISN       63            DP1I=   P1I* BO *XLOG10/(  CO +TEMP)**2                            G0030140
ISN       64          DG2DT=DP1I*XMAS1I/FEO                                                G0030150
ISN       65          DPPOIL=DG2DT*FEO*(ONE+G2*(TWO+G2*(4.5D0+G2*10.667D0)))               G0030160
                                                 2      3
C                                                                                          G0030170
C             I.E.   DG2DT*FEO * (1.0 + 2.0*G2 + 4.5*G2   + 10.667*G2   )                 G0030180
ISN       66          IF (    (XMOL1I.GT.ZERO)) DPOILI=DPPOIL/XMOL1I                       G0030190
ISN       68          IF (.NOT.(XMOL1I.GT.ZERO)) DPOILI=FMSML*DP1I                         G0030200
ISN       70          DERIV=DPMATI+DPPOIL+XMOLE(2,I)*DPSOLI                                G0030210
ISN       71          IF (.NOT.TCHNGE) GO TO 90                                            G0030220
ISN       72          TEMP=OTEMP-FUNCTN/DERIV                                              G0030230
ISN       73          TEST=DABS(TEMP-OTEMP)/(OTEMP+273.15D0)*100.D0                        G0030240
ISN       74          T(I)=TEMP                                                            G0030250
C             IF (TEST.GT.5.000)                                                           G0030260
C     1 T(I)=AMAX1((OTEMP-13.7D0),AMIN1(T(I),(OTEMP+16.3D0)))                            G0030270
C             I.E. IF TEST > 5.0, THEN OTEMP-13.7 <= T(I) <= OTEMP+16.3 .                  G0030280
ISN       75          ITER=ITER+1                                                          G0030290
ISN       76          IF (ITER.GT.50) THEN                                                 G0030300
ISN       77            IERR=I                                                             G0030310
ISN       78            IWRONG=I                                                           G0030320
ISN       79            CALL ERRMSG(11,IWRONG,ITER,OTEMP,TEMP)                             G0030330
C               I.E. CALL SUBROUTINE ERRMSG(L,I1,I2,R1,R2)                                 G0030340
ISN       80            RETURN                                                             G0030350
ISN       81          END IF                                                               G0030360
ISN       82          IF (TEST.GT.1.0D-11) GO TO 50                                        G0030370
ISN       83          T(I)=OTEMP                                                           G0030380
C             THE T(I)=OTEMP TRICK MIGHT MAKE IT POSSIBLE                                  G0030390
C             TO GET RID OF THE TOHOLD KLUDGE.                                             G0030400
ISN       84       90 CONTINUE                                                             G0030410
ISN       85          PMAT(I)=PMATI                                                        G0030420
ISN       86          POIL(I)=POILI                                                        G0030430
ISN       87          PSOL(I)=PSOLI                                                        G0030440
ISN       88          IF (DERIVS) THEN                                                     G0030450
ISN       89            DPMAT(I)=DPMATI                                                    G0030460
ISN       90            DPOIL(I)=DPOILI                                                    G0030470
ISN       91            DPSOL(I)=DPSOLI                                                    G0030480
ISN       92          END IF                                                               G0030490
ISN       93      101 FORMAT(' ***<<< VPTEMP: TCHNGE IS TRUE, BUT DERIVS IS FALSE.')       G0030500
ISN       94      102 FORMAT(' ***<<< VPTEMP: TCHNGE AND LMAGF ARE BOTH TRUE.')           G0030510
ISN       95      103 FORMAT(1X,'VPTEMP: AT CHECKPOINT ',I2,'    T(',I2,')=',F8.3,        G0030520
                     1          '  TEMP=',F8.3)                                          G0030530
ISN       96          ICHECK=2                                                           G0030540
ISN       97          IF (.NOT.NORMAL) WRITE(6,103)ICHECK,I,T(I),TEMP                    G0030550
ISN       99          RETURN                                                             G0030560
ISN      100          END                                                                G0030570
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STATISTICS SOURCE STATEMENTS = 89, PROGRAM SIZE = 6100 BYTES, PROGRAM NAME = VPTEMP PAGE: 59.

STATISTICS NO DIAGNOSTICS GENERATED.

VPTEMP END OF COMPILATION 9 ******

OPTIONS IN EFFECT: NOLIST NOMAP NOXREF NOGOSTMT NODECK SOURCE TERM NOOBJECT FIXED NOTEST TRMFLG SRCFLG
NOSYM NORENT SDUMP AUTODBL(NONE) NOSXM IL
OPT(0) LANGLVL(77) NOFIPS FLAG(I) NAME(MAIN) LINECOUNT(60) CHARLEN(500)

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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
                C.PROPTY                                                                          G0030580
                C                                                                                 G0030590
                C  S12.  CALCULATE FLUID AND RESERVOIR PROPERTIES.                                G0030600
                C                                                                                 G0030610
ISN         1       SUBROUTINE PROPTY(ISTART,IFINIS,LCTNPH,IJOB)                                  G0030620
                C       THIS GOES WITH SCEQNS8.                                                   G0030630
ISN         2       IMPLICIT DOUBLE PRECISION (A-H,K,O-Z)                                         G0030640
                C                                                                                 G0030650
ISN         3       LOGICAL NORMAL,CALPRM,PRMDRV,PFIXED                                           G0030660
ISN         4       LOGICAL BOUNLF,BOUNRT                                                         G0030670
ISN         5       DOUBLE PRECISION DIRODX(3)                                                    G0030680
ISN         6       LOGICAL LOUTP                                                                 G0030690
                C                                                                                 G0030700
ISN         7       LOGICAL EQMAO1,EQMA1O,VOUCPT,VOUCSC,EQUIL                                     G0030710
ISN         8       LOGICAL COORTR,TRACKF,DYTAKE,DATAFR,RESTRT                                    G0030720
ISN         9       LOGICAL OUT,REPEAT,JCTEST,JTINIT,ITERPR,BYWEIT                                G0030730
ISN        10       DOUBLE PRECISION LAMBDA                                                       G0030740
ISN        11       LOGICAL SWIT1,SWIT2,SWIT3,SWIT4,SWIT5,SWIT6,SWIT7,SWIT8                       G0030750
ISN        12       DOUBLE PRECISION MO,MWOIL,MSOL,MGP                                            G0030760
ISN        13       DOUBLE PRECISION MOBGL,MOBWL,MOBOL,MOBTL                                      G0030770
ISN        14       LOGICAL RCONDL                                                                G0030780
ISN        15       DOUBLE PRECISION MOBGR,MOBWR,MOBOR,MOBTR                                      G0030790
ISN        16       LOGICAL RCONDR                                                                G0030800
ISN        17       LOGICAL LFRNT                                                                 G0030810
ISN        18       LOGICAL LBNDOG,LBNDB                                                          G0030820
ISN        19       LOGICAL RCOND,INJECT                                                          G0030830
ISN        20       DOUBLE PRECISION MOBG,MOBW,MOBO,MOBT                                          G0030840
                C                                                                                 G0030850
ISN        21       COMMON/PRMBLK/SWC,SOIRR,SGIRR,SGPDUM,SWPDUM,KRGDUM,KROG,KROW,                 G0030860
                1                KRWDUM,KRODUM,KRGSGD,KROGSG,KROWSW,KRWSWD,KROSGD,             G0030870
                2                KROSWD,PCHDUM,PCVDUM,                                          G0030880
                3                LCTN,IERR,IWRONG                                               G0030890
ISN        22       COMMON/PVAPOR/PMAT(55),POIL(55),PSOL(55),DPMAT(55),DPOIL(55),                 G0030900
                1                DPSOL(55),DPDT(55),YMOLE(4,55),YO(55),YV(55),YS(55)           G0030910
ISN        23       COMMON/EQLBRM/PEQUIL,                                                         G0030920
                1                EQMAO1,EQMA1O,VOUCPT,VOUCSC,EQUIL(55)                         G0030930
ISN        24       COMMON/VPCONS/AN,BN,AO,BO,CO,ASOL,BSOL,CSOL,TO(55)                            G0030940
ISN        25       COMMON/INJSPC/PGRDNT,TOTINJ,VAPINJ(28),HCBINJ(28),MATINJ(28),                 G0030950
                1                VLCTY,HC1INJ(28),HC2INJ(28),HC3INJ(28),                       G0030960
                2                VOTINJ(28),VO2INJ(28),VWAINJ(28)                              G0030970
ISN        26       COMMON/GRIPRO/DT,DXFRNT,DISXN,DX(57),DISTX(58),MFRONT,NBLOKS,                 G0030980
                1                NG,NJAY,COORTR,TRACKF,DYTAKE,DATAFR,RESTRT                    G0030990
ISN        27       COMMON/LOGMIS/OUT,REPEAT,JCTEST,JTINIT,ITERPR,BYWEIT                          G0031000
ISN        28       COMMON/STATEV/SMP(55),SGP(55),SOP(55),T(55),P(55),                            G0031010
                1                XMOLE(3,55),XO(55),XSOL(55),XW(55)                            G0031020
ISN        29       COMMON/FLUPRO/DMP(55),DOP(55),DGP(55),DWP(55),UOP(55),UGP(55),                G0031030
                1                CMP(55),COP(55),CGP(55),KO(55),KSOL(55),LAMBDA(55),           G0031040
                2                DENSOL(55),DENSOW(55),DENSOS(55),                             G0031050
                3                DFSPCW(55),DFSPCO(55),DFSPCV(55),GASCON                       G0031060
ISN        30       COMMON/HVAPOR/HVAPS,HVAPO,HVAPSV                                              G0031070
ISN        31       COMMON/RESPRO/KA,KC(55),PHI(55),DBCB(55),PCAPW(55),PCAPV(55)                  G0031080
ISN        32       COMMON/PRM123/KRGP(55),KROP(55),KRWP(55),AKROG(55),AKROW(55)                  G0031090
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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
ISN        33       COMMON/CPLCPV/CPLWA(55),CPVWA(55),CPLOL(55),CPVOL(55),                        G0031100
                1                CPLOS(55),CPVOS(55),CPLOW(55)                                 G0031110
ISN        34       COMMON/SWIT  /SWIT1,SWIT2,SWIT3,SWIT4,SWIT5,SWIT6,SWIT7,SWIT8                G0031120
ISN        35       COMMON/MWEITS/MO,MWOIL,MSOL,MGP,RTMWAT,RTMOIL,RTMINT,RTMSOL                   G0031130
ISN        36       COMMON/LNHOLD/XLOG10                                                          G0031140
ISN        37       COMMON/INJCND/RATEL,PSPECL,MOBGL,MOBWL,MOBOL,MOBTL,                           G0031150
                1                AINJV,TSPECL,                                                 G0031160
                2                RCONDL                                                        G0031170
ISN        38       COMMON/PRDCND/RATER,PSPECR,MOBGR,MOBWR,MOBOR,MOBTR,                           G0031180
                1                PRODV,TSPECR,                                                 G0031190
                2                RCONDR                                                        G0031200
ISN        39       COMMON/ENHLPY/ENHLWA(55),ENHVWA(55),ENHLOS(55),ENHVOS(55),                    G0031210
                1                ENHLOL(55),ENHVOL(55),ENHLOW(55),                             G0031220
                2                ENHWP(55) ,ENHOP(55) ,ENHVP(55)                               G0031230
                3                ENHWPH,ENHGPH,ENHOPH,ENHOPH,ENHVPH,ENHVPH                     G0031240
ISN        40       COMMON/TABLE1/TACTEM(12),TALMUO(12),TALMUW(12),TAMMUG(12),                    G0031250
                1                IENTTI(55),NENTTI                                             G0031260
ISN        41       COMMON/TABLE2/TABXN(8),TABUOR(8),IENTXN(55),NENTXN                            G0031270
ISN        42       COMMON/TABLE3/TABSW(16),TABKRW(16),TABKOW(16),TABPCW(16),                     G0031280
                1                IENTSW(55),NENTSW                                             G0031290
ISN        43       COMMON/TABLE4/TABSL(18),TABKRG(18),TABKOG(18),TABPCV(18),                     G0031300
                1                IENTSL(55),NENTSL                                             G0031310
ISN        44       COMMON/TABLE5/STMTAB(20,6),IENTT2(55),NENTT2                                  G0031320
ISN        45       COMMON/ERROR1/ITABL                                                           G0031330
ISN        46       COMMON/BASICS/ZERO,HALF,ONE,TWO                                               G0031340
ISN        47       COMMON/MAXES /NGRPMX                                                          G0031350
ISN        48       COMMON/DIMENS/NDIMNS,NX,NY,NOS,NRS,NRFW,NRFP                                  G0031360
ISN        49       COMMON/TABLS1/NBLKS,NGRPS,JGRPOG(50),JAGPOF(9,16),                            G0031370
                1                JBLK(54),JFPT(55)                                             G0031380
ISN        50       COMMON/TABL1A/LFRNT(55)                                                       G0031390
ISN        51       COMMON/BTBLS1/NBNDBS,JBNDOG(55),JBNDB(50),JBLKOB(28),JINTOB(28)               G0031400
ISN        52       COMMON/BTBL1A/LBNDOG(55),LBNDB(50)                                            G0031410
ISN        53       COMMON/SPEC4 /RCOND(28),INJECT(28)                                            G0031420
ISN        54       COMMON/BNOBS /MOBG(28),MOBW(28),MOBO(28),MOBT(28)                             G0031430
ISN        55       COMMON/GRAVTY/GX,GY,DENWSW(55),DENMSO(55),DENMSV(55),GRAVP(55)                G0031440
ISN        56       COMMON/TABLS2/NRLGS,JGRPOF(16),JRLG(55),JGRPOR(54),                           G0031450
                1                JGPTWR(55),JTYFRN(55),JTYRFL(55),JRFLIM(55)                   G0031460
                C                                                                              G0031470
ISN        57       LCTN=LCTNPH                                                                   G0031480
                C                                                                              G0031490
                C                        VAPOUR PRESSURES                                      G0031500
                C                                                                              G0031510
                C                                                                              G0031520
ISN        58       DO 199 I=ISTART,IFINIS,1                                                      G0031530
                C                                                                              G0031540
ISN        59       NORMAL=.TRUE.                                                                 G0031550
ISN        60       EQMAO1=.FALSE.                                                                G0031560
ISN        61       PFIXED=.FALSE.                                                                G0031570
                C       PFIXED STAYS .FALSE. IF NDIMNS IS 1 OR LESS, AND THE                   G0031580
                C       FOLLOWING IF CONDITION IS .FALSE.                                      G0031590
ISN        62       IF (LBNDOG(I)) PFIXED=.NOT.RCOND(JBNDOG(I))                                   G0031600
ISN        64       IF (NDIMNS.GE.2) PFIXED=.TRUE.                                                G0031610
                C                                                                              G0031620
ISN        66       IF (.NOT.(PFIXED.AND.EQUIL(I))) THEN                                          G0031630
                C                                                                              G0031640
ISN        67          CALL VPTEMP(I,.TRUE.,.FALSE.,.TRUE.,.FALSE.,                               G0031650
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                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
                     1              LCTN,NGRPMX,P,XMOLE,                                  G0031660
                     2              PEQUIL,T,PHAT,POIL,PSOL,                              G0031670
                     3              DPHAT,DPOIL,DPSOL,IERR,IWRONG)                        G0031680
                C         I.E. CALL VPTEMP(IPARM,NORMAL,TCHNGE,DERIVS,LHALF,            G0031690
                CCC                        LCTN,NGRPMX,P,XMOLE,                          G0031700
                CCC                        PEQUIL,T,PHAT,POIL,PSOL,                      G0031710
                CCC                        DPHAT,DPOIL,DPSOL,IERR,IWRONG)                G0031720
ISN       68          IF (IERR.NE.0) RETURN                                              G0031730
                C                                                                        G0031740
ISN       70          IF (EQUIL(I).AND..NOT.PFIXED) P(I)=PEQUIL                          G0031750
                C       OF COURSE, PFIXED IS .TRUE. IF NDIMNS IS 2 OR LARGER.            G0031760
ISN       72          IF ((.NOT.EQUIL(I)).AND.PEQUIL.GT.P(I)) THEN                       G0031770
ISN       73            IF (COORTR) THEN                                                 G0031780
ISN       74              LOUTP=(LCTNPM.EQ.09.OR.LCTNPM.EQ.61).AND..NOT.SWIT2            G0031790
ISN       75              IF (LOUTP) WRITE(6,55)I,T(I),PEQUIL,P(I),LCTNPM                G0031800
ISN       77              IF (LOUTP) WRITE(6,52)                                         G0031810
ISN       79   52         FORMAT(' PROPTY: NEVERTHELESS, EQUIL IS NOT SET',              G0031820
                1                ' TO TRUE SINCE COORTR IS TRUE.')                       G0031830
ISN       80            ELSE                                                           G0031840
ISN       81              NORMAL=.FALSE.                                               G0031850
ISN       82              EQMA01=.TRUE.                                                G0031860
ISN       83              EQUIL(I)=.TRUE.                                              G0031870
ISN       84              VOLCPT=.TRUE.                                                G0031880
ISN       85              VOLCSC=.TRUE.                                                G0031890
ISN       86   55         FORMAT(' PROPTY; I= ',I2,                                    G0031900
                1                ' T(I)= ',F10.4,' PEQUIL= ',D12.4,                    G0031910
                2                ' P(I)= ',D12.4,' LCTNPM= ',I2)                       G0031920
ISN       87              WRITE(6,55)I,T(I),PEQUIL,P(I),LCTNPM                         G0031930
ISN       88            END IF                                                         G0031940
ISN       89          END IF                                                           G0031950
ISN       90        END IF                                                             G0031960
                C                                                                        G0031970
ISN       91        IF (EQMA01.OR.(PFIXED.AND.EQUIL(I)))                               G0031980
                1 CALL VPTEMP(I,NORMAL,.TRUE.,.TRUE.,.FALSE.,                           G0031990
                2             LCTN,NGRPMX,P,XMOLE,                                      G0032000
                3             PEQUIL,T,PHAT,POIL,PSOL,                                  G0032010
                4             DPHAT,DPOIL,DPSOL,IERR,IWRONG)                            G0032020
                CCC      I.E. CALL VPTEMP(IPARM,NORMAL,TCHNGE,DERIVS,LHALF,            G0032030
                CCC                        LCTN,NGRPMX,P,XMOLE,                          G0032040
                CCC                        PEQUIL,T,PHAT,POIL,PSOL,                      G0032050
                CCC                        DPHAT,DPOIL,DPSOL,IERR,IWRONG)                G0032060
ISN       93          IF (IERR.NE.0) RETURN                                            G0032070
                CCC                                                                      G0032080
                CCC                                                                      G0032090
                CCC                                                                      G0032100
                C                                                                        G0032110
ISN       95        IF (TRACKF.AND.LFRMT(I).AND..NOT.COORTR) EQUIL(I)=.TRUE.           G0032120
ISN       97    199 CONTINUE                                                           G0032130
                C                                                                        G0032140
ISN       98        CALL TABENT(ISTART,IFINIS,LCTN,NGRPMX,12,8,16,18,20,               G0032150
                1             .TRUE. ,NENTTI,TACTEM,TALMUO,TALMUN,TAMMUG,!ENTTI,       G0032160
                2             .TRUE. ,NENTXN,TABXN ,TABUOR,              !ENTXN,       G0032170
                3             .FALSE.,NENTSM,TABSM ,TABKRM,TABKOM,TABPCM,!ENTSM,       G0032180
                4             .FALSE.,NENTSL,TABSL ,TABKRG,TABKOG,TABPCV,!ENTSL,       G0032190
                5             .TRUE. ,NENTT2,STMTAB                      !ENTT2,       G0032200
                6             ITABL,IERR,IWRONG)                                        G0032210
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                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
                CCC      I.E. CALL SUBROUTINE TABENT(ISTART,IFINIS,LCTN,NGRPMX,         G0032220
                CCC                        NMXTI,NMXXN,NMXSM,NMXSL,NMXT2,                G0032230
                CCC                        LTI,NENTTI,TACTEM,TALMUO,TALMUN,TAMMUG,!ENTTI, G0032240
                CCC                        LXN,NENTXN,TABXN ,TABUOR,              !ENTXN, G0032250
                CCC                        LSM,NENTSM,TABSM ,TABKRM,TABKOM,TABPCM,!ENTSM, G0032260
                CCC                        LSL,NENTSL,TABSL ,TABKRG,TABKOG,TABPCV,!ENTSL, G0032270
                CCC                        LT2,NENTT2,STMTAB                      !ENTT2, G0032280
                CCC                        ITABL,IERR,IWRONG)                             G0032290
ISN       99        IF (ITABL.NE.0) RETURN                                             G0032300
                C                                                                        G0032310
ISN      101        DO 599 I=ISTART,IFINIS,1                                           G0032320
                C                                                                        G0032330
ISN      102          XOI=XMOLE(1,I)                                                   G0032340
ISN      103         XSOLI=XMOLE(2,I)                                                  G0032350
ISN      104           XNI=XMOLE(3,I)                                                  G0032360
ISN      105        XMOL1I=XMOLE(1,I)                                                 G0032370
ISN      106        XMOL2I=XMOLE(2,I)                                                 G0032380
ISN      107        XMOL3I=XMOLE(3,I)                                                 G0032390
ISN      108        SGPDUM=SGP(I)                                                     G0032400
ISN      109        SNPDUM=SNP(I)                                                     G0032410
ISN      110        BOUNLF=I.EQ.1                                                     G0032420
ISN      111        BOUNRT=I.GE.NG                                                    G0032430
                C                                                                        G0032440
ISN      112        PSUM=PHAT(I)+XMOLE(1,I)*POIL(I)+XMOLE(2,I)*PSOL(I)                G0032450
ISN      113        YS(I)=PHAT(I)/PSUM                                                G0032460
ISN      114        KO(I)=POIL(I)/PSUM                                                G0032470
ISN      115        YO(I)=XMOLE(1,I)*XOI                                              G0032480
ISN      116        KV(I)=PSOL(I)/PSUM                                                G0032490
ISN      117        YV(I)=XMOLE(2,I)*KVI                                              G0032500
ISN      118        PTOTI=DMAX1(PSUM,P(I))                                            G0032510
ISN      119        YMOLE(4,I)=PHAT(I)/PTOTI                                          G0032520
ISN      120        KO(I)=POIL(I)/PTOTI                                               G0032530
ISN      121        KSOL(I)=PSOL(I)/PTOTI                                             G0032540
ISN      122        YMOLE(1,I)=  KO(I)*XMOLE(1,I)                                     G0032550
ISN      123        YMOLE(2,I)=KSOL(I)*XMOLE(2,I)                                     G0032560
                C                                                                        G0032570
ISN      124        PI=P(I)                                                           G0032580
ISN      125        TI=T(I)                                                           G0032590
ISN      126        IF (IJOB.LT.0) GO TO 500                                          G0032600
ISN      127        TINF=TI*1.8D0+32.D0                                               G0032610
ISN      128        TINK=TI+273.15D0                                                  G0032620
ISN      129        TAV=(TI+12.800)*0.5D0                                             G0032630
ISN      130        DLOGTK=DLOG(TINK)                                                 G0032640
                CCC                                                                      G0032650
                CCC                                                                      G0032660
                CCC           CRITICAL  PROPERTIES  AND  LATENT  HEATS                   G0032670
                CCC                                                                      G0032680
                CCC                                                                      G0032690
                CCC     OIL COMPONENT                                                    G0032700
                CCC                                                                      G0032710
                C                                                                        G0032720
ISN      131        TCRITO=617.7 D0                                                   G0032730
ISN      132        HVAPSV=0.0 D0                                                     G0032740
ISN      133        IF(TCRITO.GT.TINK)HVAPSV=5.58D6*(TCRITO-TINK)**0.38               G0032750
                C                                                                        G0032760
                C     METHANE                                                          G0032770
```

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                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
C                                                                       G0032780
C                                                                       G0032790
C       HVAPO = R*LN10*BO    R = GASCON = 8314 J/(KMOL*K) , BO = 110 .  G0032800
C       HVAPOI AND ITS DERIVATIVE DHVPOI ARE OBTAINED                   G0032810
C       VIA DENBIGH'S EQUATION (8.34),  FROM THE METHANE SOLUBILITY     G0032820
C       FORMULA IN THE EMR PHASE I PART 2 REPORT, PAGE 53,              G0032830
C       THUS CONTRADICTING SECTION 5.4.4 IN THIS EMR REPORT.            G0032840
C       NOTE THAT DENBIGH'S XI IS A MOLE FRACTION, WHEREAS THE EMR      G0032850
C       REPORT'S X1MAT IS A MASS FRACTION, RELATED TO X1 BY THE FORMULA G0032860
C       X1MAT = 100*X1*(M1/M3)/(1-X1*(1-M1/M3))                         G0032870
C       M1 AND M3 ARE MOLECULAR WEIGHTS: M1==MO, M3==MOIL.              G0032880
ISN     135           XMOLAD=XMOLE(1,I)*(ONE-MO/MOIL)                   G0032890
ISN     136           HVAPOI=HVAPO*(ONE-XMOLAD)                         G0032900
ISN     137           DHVPOI=(HVAPO**2)/(GASCON*TINK**2)*XMOLAD*(ONE-XMOLAD)  G0032910
C                                                                       G0032920
C                                     WATER                             G0032930
C                                                                       G0032940
C                                                                       G0032950
                       DMP(I)=55.5D0*(1.D0-1.04D-3*(TI-32.2)+4.5D-10*(PI-1.D5))  G0032960
ISN     138            IE=IENTTI(I)                                     G0032970
ISN     139            X1 = TALMUM(IE) + (TALMUM(IE+1)-TALMUM(IE))      G0032980
     1                                 *(DLOGTK-TACTEM(IE))/(TACTEM(IE+1)-TACTEM(IE))  G0032990
ISN     140            UMP(I)=DEXP(X1)                                  G0033000
ISN     141            DFSPCH(I)=ZERO                                   G0033010
                       CMP(I)=(1.746477D-4*TAV-3.704971D-2)*TAV+2.13129200)*TAV  G0033020
     1                        +7.52731404                               G0033030
                       CPLMA(I)=CMP(I)                                  G0033040
                       ENHLMA(I)=TI*CPLMA(I)                            G0033050
                       ENHMP(I)=ENHLMA(I)                               G0033060
C                                                                       G0033070
C                      INTERPOLATE STEAM PROPERTIES FROM STEAM TABLES    G0033080
C                                                                       G0033090
ISN     142              IE=IENTT2(I)                                   G0033100
ISN     143             TFAC= (TI-STMTAB(IE,1)) /(STMTAB(IE+1,1)-STMTAB(IE,1))  G0033110
ISN     144              DMP(I)  =STMTAB(IE,3)+(STMTAB(IE+1,3)-STMTAB(IE,3))*TFAC  G0033120
ISN     145              DSTEAM  =STMTAB(IE,4)+(STMTAB(IE+1,4)-STMTAB(IE,4))*TFAC  G0033130
ISN     146             ENHLMA(I)=STMTAB(IE,5)+(STMTAB(IE+1,5)-STMTAB(IE,5))*TFAC  G0033140
ISN     147             ENHVMA(I)=STMTAB(IE,6)+(STMTAB(IE+1,6)-STMTAB(IE,6))*TFAC  G0033150
ISN     148             ENHMP(I)=ENHLMA(I)                              G0033160
ISN     149            DENMSW(I)=18.02D0*DMP(I)                         G0033170
C                        CPLMA AND CPVMA ARE PROBABLY NOT USED, BUT JUST IN CASE:  G0033180
ISN     150             CPVMA(I)=(STMTAB(IE+1,6)-STMTAB(IE,6))/         G0033190
     1                           (STMTAB(IE+1,1)-STMTAB(IE,1))          G0033200
ISN     151             CPLMA(I)=(STMTAB(IE+1,5)-STMTAB(IE,5))/         G0033210
     1                           (STMTAB(IE+1,1)-STMTAB(IE,1))          G0033220
C                                                                       G0033230
C                                     GAS                               G0033240
C                                                                       G0033250
C                                                                       G0033260
ISN     152           MGP=YSI*18.02D0+YOI*16.D0+YVI*MSOL                G0033270
ISN     153           DGP(I)= 1.D0/((YOI+YVI)/(PI/(GASCON*TINK))  +  YSI/DSTEAM)  G0033280
ISN     154           DENMSV(I)=DGP(I)*MGP                              G0033290
ISN     155           LAMBDA(I)=YSI*HVAPS+YOI*HVAPO+YVI*HVAPSV          G0033300
ISN     156           IE=IENTT1(I)                                      G0033310
ISN     157           X1 = TAMMUG(IE) + (TAMMUG(IE+1)-TAMMUG(IE))       G0033320
```



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                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
     1                                 *(DLOGTK-TACTEM(IE))/(TACTEM(IE+1)-TACTEM(IE))  G0033340
ISN     158           UGP(I)=DEXP(X1)                                   G0033350
ISN     159           DFSPCV(I)=ZERO                                    G0033360
                       A=1832.8900*YSI+2104.7300*YOI+948.7400*YVI        G0033370
                       B=0.744300*YSI+3.6967D0*YOI+4.2211D0*YVI          G0033380
                       C=-1.124D-4*YSI-1.33830-4*YOI-3.2279D-3*YVI       G0033390
                       H=-5.4428D-7*YOI+9.9377D-7*YVI                    G0033400
                      CPVMA(I)=((          -1.124 D-4)*TAV+0.744300)*TAV+1832.8900)  G0033410
     1 * 18.02D0                                                        G0033420
C                                                                       G0033430
                       CGP(I)=(((H*TAV+C)*TAV+B)*TAV+A)*MGP              G0033440
ISN     160           CPVOL(I)=33.78D3+TI*56.000                        G0033450
ISN     161           CPVOS(I)=355.6 D3                                 G0033460
ISN     162           CGP(I)=CPVMA(I)*YSI+CPVOL(I)*YOI+CPVOS(I)*YVI     G0033470
C                        THIS IS A SEMI-PERMANENT (1983/06/06) FIX.     G0033480
ISN     163           ENHVMA(I)=ENHVMA(I)                               G0033490
ISN     164           ENHVOL(I)=-2.138D6+TI*(33.78D3+TI*28.000)         G0033500
ISN     165           ENHVOS(I)=TI*CPVOS(I) + HVAPSV                    G0033510
ISN     166           ENHVP(I)=YSI*ENHVMA(I)+YOI*ENHVOL(I)+YVI*ENHVOS(I)  G0033520
C                                                                       G0033530
C                                     OIL                               G0033540
C                      THE SOLVENT PROPERTIES ARE UNRELIABLE.  THIS MATTERS LITTLE,  G0033550
C                      BECAUSE THEY ARE NOT USED IN THIS SET OF SIMULATIONS.  G0033560
C                                                                       G0033570
C                                                                       G0033580
ISN     167           DRATIO=1.D0-7.D-4*(TI-14.D0)+0.47D-09*(PI-3.17D6)  G0033590
ISN     168           DINERT=(990.000/MOIL)*DRATIO                      G0033600
ISN     169           DOIL=(990.000/MO)*DRATIO                          G0033610
ISN     170           DENSOW(I)=DINERT                                  G0033620
ISN     171           DENSOL(I)=DOIL                                    G0033630
ISN     172           DSOLT= 5.58 D0 *DRATIO                            G0033640
ISN     173           DSOL=DSOLT                                        G0033650
ISN     174           DENSOS(I)=DSOL                                    G0033660
ISN     175           MOP=XMOLE(1,I)*MO+XMOLE(2,I)*MSOL+XMOLE(3,I)*MOIL  G0033670
ISN     176           DOP(I)=1.000/(XOI/DOIL+XNI/DINERT+XSOLI/DSOL)     G0033680
ISN     177           DENMSO(I)=DOP(I)*MOP                              G0033690
ISN     178           IE=IENTXN(I)                                      G0033700
ISN     179           X1 = TABUOR(IE) + (TABUOR(IE+1)-TABUOR(IE))       G0033710
     1                                 *(XNI-TABXN(IE))/(TABXN(IE+1)-TABXN(IE))  G0033720
ISN     180           TEN=1.001                                         G0033730
ISN     181           X3=1.00-3*(TEN*(TEN*(2.15003/(TINK+3.54D2)-2.66000)))  G0033740
ISN     182           UOP(I)=X1*X3                                      G0033750
ISN     183           DFSPCO(I)=ZERO                                    G0033760
ISN     184           CPLOL(I)=CPVOL(I)-DHVPOI                          G0033770
ISN     185           CINERT=2.10*MOIL                                  G0033780
ISN     186           CPLOW(I)=CINERT                                   G0033790
ISN     187           CSOLV=2.10*MSOL                                   G0033800
ISN     188           CPLOS(I)=CSOLV                                    G0033810
ISN     189           COP(I)=XOI*CPLOL(I)+XNI*CINERT+XSOLI*CSOLV        G0033820
ISN     190           ENHLOL(I)=ENHVOL(I)-HVAPOI                        G0033830
ISN     191           ENHLOS(I)=TI*CPLOS(I)                             G0033840
ISN     192           ENHLOW(I)=TI*CPLOW(I)                             G0033850
ISN     193           ENHOP(I)=XOI*ENHLOL(I)+XSOLI*ENHLOS(I)+XNI*ENHLOW(I)  G0033860
C                                                                       G0033870
C                                     RESERVOIR                         G0033880
C                                                                       G0033890
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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
                C                                                                              G0033900
ISN      194          PHI(I)=0.3100000*(1.D0+0.5D-9*(PI-1.D5))                                 G0033910
ISN      195          C1MC12=0.3100000/(ONE-0.3100000*0.9999500)                               G0033920
ISN      196          DBCB(I)=2.3006/(ONE-C1MC12*0.5D-9*PI)                                    G0033930
ISN      197          KC(I)=2.000                                                              G0033940
                C                                                                              G0033950
                C                                PERMEABILITIES                                G0033960
                C                                                                              G0033970
ISN      198          SMPDUM=SMP(I)                                                            G0033980
ISN      199          SGPDUM=SGP(I)                                                            G0033990
ISN      200          PRMDRV=IJOB.GT.0                                                         G0034000
                C                                                                              G0034010
ISN      201          CALL PERMS(I,PRMDRV)                                                     G0034020
                C                                                                              G0034030
ISN      202          IF (IERR.NE.0) GO TO 218                                                 G0034040
ISN      203          KRMP(I)=KRMDUM                                                           G0034050
ISN      204          KRGP(I)=KRGDUM                                                           G0034060
ISN      205          KROP(I)=KRODUM                                                           G0034070
ISN      206          AKROG(I)=KROG                                                            G0034080
ISN      207          AKROM(I)=KROM                                                            G0034090
ISN      208          PCAPH(I)=0.                                                              G0034100
ISN      209          PCAPV(I)=0.                                                              G0034110
ISN      210          IF (.NOT.PRMDRV) GO TO 220                                               G0034120
ISN      211        218 CONTINUE                                                               G0034130
ISN      212        220 CONTINUE                                                               G0034140
                C                                                                              G0034150
ISN      213          IF (LBNDOG(I)) THEN                                                      G0034160
ISN      214             JBNDBJ=JBNDOG(I)                                                      G0034170
ISN      215             HOBG(JBNDBJ)=KA*KRGP(I)/UGP(I)                                        G0034180
ISN      216             HOBM(JBNDBJ)=KA*KRMP(I)/UMP(I)                                        G0034190
ISN      217             HOBO(JBNDBJ)=KA*KROP(I)/UOP(I)                                        G0034200
ISN      218             HOBT(JBNDBJ)=HOBG(JBNDBJ)+HOBM(JBNDBJ)+HOBO(JBNDBJ)                  G0034210
ISN      219             IF (NDIMMS.LE.1) THEN                                                 G0034220
ISN      220                IF (I.EQ.1) THEN                                                   G0034230
ISN      221                   HOBGL=HOBG(1)                                                   G0034240
ISN      222                   HOBML=HOBM(1)                                                   G0034250
ISN      223                   HOBOL=HOBO(1)                                                   G0034260
ISN      224                   HOBTL=HOBT(1)                                                   G0034270
ISN      225                END IF                                                             G0034280
ISN      226                IF (I.EQ.NG) THEN                                                  G0034290
ISN      227                   HOBGR=HOBG(2)                                                   G0034300
ISN      228                   HOBMR=HOBM(2)                                                   G0034310
ISN      229                   HOBOR=HOBO(2)                                                   G0034320
ISN      230                   HOBTR=HOBT(2)                                                   G0034330
ISN      231                END IF                                                             G0034340
ISN      232             END IF                                                                G0034350
ISN      233          END IF                                                                   G0034360
ISN      234        500 CONTINUE                                                               G0034370
                C                                                                              G0034380
ISN      235          IF (IERR.EQ.0) GO TO 599                                                 G0034390
ISN      236          INRONG=I                                                                 G0034400
ISN      237          LCTN=LCTNPN                                                              G0034410
ISN      238          RETURN                                                                   G0034420
                C                                                                              G0034430
ISN      239        599 CONTINUE                                                               G0034440
                C                                                                              G0034450
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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
ISN      240          RETURN                                                                   G0034460
ISN      241          END                                                                      G0034470
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STATISTICS SOURCE STATEMENTS = 230, PROGRAM SIZE = 14576 BYTES, PROGRAM NAME = PROPTY PAGE: 63.

STATISTICS NO DIAGNOSTICS GENERATED.

PROPTY END OF COMPILATION 10 ******

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OPTIONS IN EFFECT:  NOLIST NOMAP NOXREF NOGOSTMT NODECK   SOURCE   TERM NOOBJECT FIXED  NOTEST   TRMFLG   SRCFLG
                    NOSYM NORENT   SDUMP AUTODBL(NONE)  NOSXM    IL
                      OPT(0) LANGLVL(77) NOFIPS   FLAG(I)  NAME(MAIN  ) LINECOUNT(60)      CHARLEN(500)

                 *....*...1.........2.........3.........4.........5.........6.........7.*.......8
                 C.BALCFS                                                                          G0034480
                 C                                                                                 G0034490
                 C  SOO.  CALCULATE THE 'ENHCF' AND 'VOLCF' COEFFICIENTS.                          G0034500
                 C                                                                                 G0034510
ISN        1         SUBROUTINE BALCFS(ISTART,IFINIS,NCOMPS,NGRPMX,ENHCF,VOLCF)                   G0034520
                 C     CALCULATE COEFFICIENTS FOR THE ENTHALPY AND VOLUME BALANCES.               G0034530
                 C     THE OIL 'VOLCF' COEFFICIENTS DEPEND ONLY ON THE DOP(I) FORMULA,            G0034540
                 C     (GIVEN CURRENT ASSUMPTIONS ABOUT THE THREE PHASES).                        G0034550
ISN        2         IMPLICIT DOUBLE PRECISION (A-H,K,O-Z)                                         G0034560
                 C                                                                                 G0034570
ISN        3         DOUBLE PRECISION ENHCF(NCOMPS,NGRPMX),VOLCF(NCOMPS,NGRPMX)                    G0034580
ISN        4         DOUBLE PRECISION DIRODX(3)                                                    G0034590
                 C                                                                                 G0034600
ISN        5         DOUBLE PRECISION LAMBDA                                                       G0034610
                 C                                                                                 G0034620
ISN        6         COMMON/PVAPOR/PHAT(55),POIL(55),PSOL(55),DPHAT(55),DPOIL(55),                 G0034630
                1                DPSOL(55),DPDT(55),YMOLE(4,55),YO(55),YV(55),YS(55)             G0034640
ISN        7         COMMON/STATEV/SHP(55),SGP(55),SOP(55),T(55),P(55),                            G0034650
                1                XMOLE(3,55),XO(55),XSOL(55),XW(55)                              G0034660
ISN        8         COMMON/FLUPRO/DHP(55),DOP(55),DGP(55),UHP(55),UOP(55),UGP(55),                G0034670
                1                CHP(55),COP(55),CGP(55),KO(55),KSOL(55),LAMBDA(55),             G0034680
                2                DENSOL(55),DENSOH(55),DENSOS(55),                               G0034690
                3                DFSPCH(55),DFSPCO(55),DFSPCV(55),GASCON                         G0034700
ISN        9         COMMON/ENHLPY/ENHLHA(55),ENHVHA(55),ENHLOS(55),ENHVOS(55),                    G0034710
                1                ENHLOL(55),ENHVOL(55),ENHLOH(55),                               G0034720
                2                ENHHP(55),ENHOP(55),ENHVP(55),                                  G0034730
                3                ENHOHH,ENHHPH,ENHOHH,ENHOPH,ENHVHH,ENHVPH                       G0034740
ISN       10         COMMON/BASICS/ZERO,HALF,ONE,TWO                                               G0034750
ISN       11         COMMON/SCALES/SCALEP,SCALEH,SCALEV,SCALVF                                     G0034760
                 C                                                                                 G0034770
ISN       12         DO 100 I=ISTART,IFINIS,1                                                      G0034780
ISN       13            ENHCF(1,I)=SCALEH*ENHLHA(I)                                                G0034790
ISN       14            ENHCF(2,I)=SCALEH*ENHLOL(I)                                                G0034800
ISN       15            ENHCF(3,I)=SCALEH*ENHLOS(I)                                                G0034810
ISN       16            ENHCF(4,I)=SCALEH*ENHLOH(I)                                                G0034820
                 C                                                                                 G0034830
ISN       17            DENSO1=DENSOL(I)                                                           G0034840
ISN       18            DENSO2=DENSOS(I)                                                           G0034850
ISN       19            DENSO3=DENSOH(I)                                                           G0034860
                 C                                                                                 G0034870
                 C        THE DENSITY FORMULA IS:                                                  G0034880
                 C        DOP(I) = ONE/(XMOL1I/DENSO1+XMOL2I/DENSO2+XMOL3I/DENSO3)                 G0034890
                 C                                                                                 G0034900
ISN       20            VOLCF(1,I)=ONE/DHP(I)                                                      G0034910
ISN       21            VOLCF(2,I)=ONE/DENSO1                                                      G0034920
ISN       22            VOLCF(3,I)=ONE/DENSO2                                                      G0034930
ISN       23            VOLCF(4,I)=ONE/DENSO3                                                      G0034940
ISN       24      100 CONTINUE                                                                     G0034950
                 C                                                                                 G0034960
ISN       25         RETURN                                                                        G0034970
ISN       26         END                                                                           G0034980
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*STATISTICS*   SOURCE STATEMENTS = 26, PROGRAM SIZE = 2964 BYTES, PROGRAM NAME = BALCFS    PAGE:  71.
*STATISTICS*    NO DIAGNOSTICS GENERATED.
**BALCFS** END OF COMPILATION 11 ******
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OPTIONS IN EFFECT: NOLIST NOMAP NOXREF NOGOSTMT NODECK SOURCE TERM NOOBJECT FIXED NOTEST TRMFLG SRCFLG
NOSYM NORENT SDUMP AUTODBL(NONE) NOSXM IL
OPT(0) LANGLVL(77) NOFIPS FLAG(I) NAME(MAIN) LINECOUNT(60) CHARLEN(500)

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                 *....*...1.........2.........3.........4.........5.........6.........7.*.......8
                      C.SATS                                                                      G0034990
                      C                                                                           G0035000
                      C  S14.  CALCULATION OF SATURATIONS AT THE EDGE OF THE FORMATION.           G0035010
                      C                                                                           G0035020
ISN         1             SUBROUTINE SATS(J,JBNDBJ)                                             G0035030
ISN         2             IMPLICIT DOUBLE PRECISION (A-H,K,O-Z)                                 G0035040
                      C                                                                           G0035050
                      C                                                                           G0035060
ISN         3             LOGICAL OUT,REPEAT,JCTEST,JTINIT,ITERPR,BYWEIT                        G0035070
ISN         4             DOUBLE PRECISION LAMBDA                                               G0035080
                      C                                                                           G0035090
ISN         5             COMMON/PRMBLK/SWC,SOIRR,SGIRR,SGPDUM,SWPDUM,KRGDUM,KROG,KROW,         G0035100
                         1                 KRWDUM,KRODUM,KRGSGD,KROGSG,KROWSW,KRWSWD,KROSGD,  G0035110
                         2                 KROSWD,PCWDUM,PCVDUM,                              G0035120
                         3                 LCTN,IERR,IWRONG                                   G0035130
ISN         6             COMMON/INJSPC/PGRDNT,TOTINJ,VAPINJ(28),HCBINJ(28),WATINJ(28),         G0035140
                         1                 VLCTY,HC1INJ(28),HC2INJ(28),HC3INJ(28),            G0035150
                         2                 VO1INJ(28),VO2INJ(28),VWAINJ(28)                   G0035160
ISN         7             COMMON/LOGMIS/OUT,REPEAT,JCTEST,JTINIT,ITERPR,BYWEIT                  G0035170
ISN         8             COMMON/STATEV/SWP(55),SGP(55),SOP(55),T(55),P(55),                    G0035180
                         1                 XMOLE(3,55),XO(55),XSOL(55),XW(55)                 G0035190
ISN         9             COMMON/FLUPRO/DWP(55),DOP(55),DGP(55),DWP(55),UOP(55),UGP(55),        G0035200
                         1                 CWP(55),COP(55),CGP(55),KO(55),KSOL(55),LAMBDA(55),G0035210
                         2                 DENSOL(55),DENSOW(55),DENSOS(55),                  G0035220
                         3                 DFSPCW(55),DFSPCO(55),DFSPCV(55),GASCON            G0035230
ISN        10             COMMON/PRM123/KRGP(55),KROP(55),KRWP(55),AKROG(55),AKROW(55)          G0035240
ISN        11             COMMON/BASICS/ZERO,HALF,ONE,TWO                                       G0035250
                      C                                                                           G0035260
                      C                                                                           G0035270
ISN        12             CALL PROPTY(J,J,0,0)                                                  G0035280
                      C        TO, CALL SUBROUTINE PROPTY(ISTART,IFINIS,LCTNPH,IJOB)            G0035290
ISN        13             IF (IERR.NE.0) RETURN                                                 G0035300
                      C                                                                           G0035310
ISN        15             PRWOIL=WCBINJ(JBNDBJ)*UOP(J)                                          G0035320
ISN        16             PRWGAS=VAPINJ(JBNDBJ)*UGP(J)                                          G0035330
ISN        17             PRWWAT=WATINJ(JBNDBJ)*UWP(J)                                          G0035340
ISN        18             IF (.NOT.BYWEIT) GO TO 50                                             G0035350
ISN        19             PRWOIL=PRWOIL/DOP(J)                                                  G0035360
ISN        20             PRWGAS=PRWGAS/DGP(J)                                                  G0035370
ISN        21             PRWWAT=PRWWAT/DWP(J)                                                  G0035380
ISN        22           50 CONTINUE                                                             G0035390
                      C  DAMPING FACTOR PREVENTS OVERSHOOTS.                                      G0035400
ISN        23             FDAMP=0.5D0                                                           G0035410
                      C  THERE ARE SEVEN CASES, DEPENDING ON WHICH PHASES ARE INJECTED.           G0035420
ISN        24             ICASE=0                                                               G0035430
ISN        25             IF (HCBINJ(JBNDBJ).GT.ZERO) ICASE=4                                   G0035440
ISN        27             IF (VAPINJ(JBNDBJ).GT.ZERO) ICASE=ICASE+2                             G0035450
ISN        29             IF (WATINJ(JBNDBJ).GT.ZERO) ICASE=ICASE+1                             G0035460
ISN        31             GO TO (110,120,130,140,150,160,170,180),ICASE                         G0035470
ISN        32           110 CONTINUE                                                            G0035480
                      C  ONLY WATER IS INJECTED.                                                  G0035490
ISN        33             SGP(J)=SGIRR                                                          G0035500
```



```
                 *....*...1.........2.........3.........4.........5.........6.........7.*.......8
ISN        34             SOP(J)=SOIRR                                                          G0035510
ISN        35             SWP(J)=1.0D0-SGIRR-SOIRR                                              G0035520
ISN        36             RETURN                                                                G0035530
ISN        37           120 CONTINUE                                                            G0035540
                      C  ONLY GAS IS INJECTED.                                                    G0035550
ISN        38             SOP(J)=SOIRR                                                          G0035560
ISN        39             SWP(J)=SWC                                                            G0035570
ISN        40             SGP(J)=1.0D0-SOIRR-SWC                                                G0035580
ISN        41             RETURN                                                                G0035590
ISN        42           130 CONTINUE                                                            G0035600
                      C  ONLY WATER AND GAS ARE INJECTED.                                         G0035610
ISN        43             SOP(J)=SOIRR                                                          G0035620
ISN        44             SWPDUM=0.5D0                                                          G0035630
ISN        45             SGPDUM=1.0D0-SOIRR-SWPDUM                                             G0035640
ISN        46           135 CONTINUE                                                            G0035650
ISN        47             CALL PERMS(J,.TRUE.)                                                  G0035660
ISN        48             FVALUE=PRWGAS*KRWDUM-PRWWAT*KRGDUM                                    G0035670
ISN        49             DERIV =PRWGAS*KRWSWD+PRWWAT*KRGSGD                                    G0035680
ISN        50         47103 FORMAT(' DBGSAT ',11D11.4)                                          G0035690
ISN        51             WRITE(6,47103)SWPDUM,SGPDUM,PRWGAS,PRWWAT,KRWDUM,KRGDUM,              G0035700
                        1 KRWSWD,KRGSGD,FVALUE,DERIV                                          G0035710
ISN        52             SWPDUM=SWPDUM-FDAMP*FVALUE/DERIV                                      G0035720
ISN        53             SGPDUM=1.0D0-SOIRR-SWPDUM                                             G0035730
ISN        54             IF (DABS(FVALUE/PRWWAT).GT.1.0D-6) GO TO 135                          G0035740
ISN        55             SGP(J)=SGPDUM                                                         G0035750
ISN        56             SWP(J)=SWPDUM                                                         G0035760
ISN        57             RETURN                                                                G0035770
ISN        58           140 CONTINUE                                                            G0035780
                      C  ONLY LIQUID ORGANIC SUBSTANCES ARE INJECTED.                             G0035790
ISN        59             SGP(J)=SGIRR                                                          G0035800
ISN        60             SWP(J)=SWC                                                            G0035810
ISN        61             SOP(J)=1.0D0-SGIRR-SWC                                                G0035820
ISN        62             RETURN                                                                G0035830
ISN        63           150 CONTINUE                                                            G0035840
                      C  ONLY LIQUID ORGANIC SUBSTANCES AND WATER ARE INJECTED.                   G0035850
ISN        64             SGP(J)=SGIRR                                                          G0035860
ISN        65             SGPDUM=SGIRR                                                          G0035870
ISN        66             SWPDUM=0.5D0                                                          G0035880
ISN        67           155 CONTINUE                                                            G0035890
ISN        68             CALL PERMS(J,.TRUE.)                                                  G0035900
ISN        69             FVALUE=PRWO*(1.-KRWDUM-PRWWAT*KRODUM                                  G0035910
ISN        70             DERIV =PRWO*(1.*KRWSWD-PRWWAT*KROSWD                                  G0035920
ISN        71             SWPDUM=SWPDUM-FDAMP*FVALUE/DERIV                                      G0035930
ISN        72             IF (DABS(FVALUE/PRWWAT).GT.1.0D-6) GO TO 155                          G0035940
ISN        73             SWP(J)=SWPDUM                                                         G0035950
ISN        74             SOP(J)=1.0D0-SGIRR-SWPDUM                                             G0035960
ISN        75             RETURN                                                                G0035970
ISN        76           160 CONTINUE                                                            G0035980
                      C  ONLY LIQUID ORGANIC SUBSTANCES AND GAS ARE INJECTED.                     G0035990
ISN        77             SWP(J)=SWC                                                            G0036000
ISN        78             SWPDUM=SWC                                                            G0036010
ISN        79             SGPDUM=0.5D0                                                          G0036020
ISN        80           165 CONTINUE                                                            G0036030
ISN        81             CALL PERMS(J,.TRUE.)                                                  G0036040
ISN        82             FVALUE=PRWO*(1.*KRGDUM-PRWGAS*KRODUM                                  G0036050
ISN        83             DERIV =PRWO*(1.*KRGSGD-PRWGAS*KROSGD                                  G0036060
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                    *....*...1.....2.....3.....4.....5.....6.....7.*.......8
ISN       84              SGPDUM=SGPDUM-FDAMP*FVALUE/DERIV                                        G0036070
ISN       85              IF (DABS(FVALUE/PRMGAS).GT.1.0D-6) GO TO 165                            G0036080
ISN       86              SGP(J)=SGPDUM                                                           G0036090
ISN       87              SOP(J)=1.0D0-SGPDUM-SMC                                                 G0036100
ISN       88              RETURN                                                                  G0036110
ISN       89            170 CONTINUE                                                              G0036120
                      C  ALL THREE PHASES ARE INJECTED.                                           G0036130
ISN       90              SMPDUM=0.4D0                                                            G0036140
ISN       91              SGPDUM=0.2D0                                                            G0036150
ISN       92            175 CONTINUE                                                              G0036160
ISN       93              CALL PERMS(J,.TRUE.)                                                    G0036170
ISN       94              F1 =PRMOIL*KRMDUM-PRMMAT*KROOUM                                         G0036180
ISN       95              F2 =PRMOIL*KRGDUM-PRMGAS*KROOUM                                         G0036190
ISN       96              G11=PRMMAT*KROSMD-PRMOIL*KRMSMD                                         G0036200
ISN       97              G12=PRMMAT*KROSGD                                                       G0036210
ISN       98              G21=PRMGAS*KROSMD                                                       G0036220
ISN       99              G22=PRMGAS*KROSGD-PRMOIL*KRGSGD                                         G0036230
ISN      100              DETERM=G11*G22-G12*G21                                                  G0036240
ISN      101              SMPDUM=SMPDUM-FDAMP*( G22*F1-G12*F2)/DETERM                             G0036250
ISN      102              SGPDUM=SGPDUM-FDAMP*(-G21*F1+G11*F2)/DETERM                             G0036260
ISN      103              IF ((DABS(F1/PRMMAT)+DABS(F2/PRMGAS)).GT.1.0D-6) GO TO 175              G0036270
ISN      104              SGP(J)=SGPDUM                                                           G0036280
ISN      105              SWP(J)=SMPDUM                                                           G0036290
ISN      106              SOP(J)=1.0D0-SGPDUM-SMPDUM                                              G0036300
ISN      107              RETURN                                                                  G0036310
ISN      108              END                                                                     G0036320
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STATISTICS SOURCE STATEMENTS = 104, PROGRAM SIZE = 5212 BYTES, PROGRAM NAME = SATS PAGE: 73.

STATISTICS NO DIAGNOSTICS GENERATED.

SATS END OF COMPILATION 12 ******


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OPTIONS IN EFFECT:  NOLIST NOMAP NOXREF NOGOSTMT NODECK   SOURCE   TERM NOOBJECT FIXED  NOTEST   TRMFLG   SRCFLG
                    NOSYM NORENT   SDUMP AUTODBL(NONE)   NOSXM    IL
                      OPT(0) LANGLVL(77) NOFIPS   FLAG(I)  NAME(MAIN  )  LINECOUNT(60)      CHARLEN(500)

                    *....*...1.....2.....3.....4.....5.....6.....7.*.......8
                      C.INPUT2                                                                    G0036330
                      C                                                                           G0036340
                      C   S22.  READ THE INFORMATION ABOUT THE BLOCK GEOMETRY.                    G0036350
                      C                                                                           G0036360
ISN        1                SUBROUTINE INPUT2(NDIMNS,COORTR,TRACKF,NXMAX,NU1MAX,NU2MAX,NFPTMX,G0036370
                       1                       NU1S,NU2S,NRFM,NRFP,NFPTOT,                        G0036380
                       2                       DX,GLINU1,GLINU2,BLOKU1,BLOKU2,FRNDIS,             G0036390
                       3                       FPHV,FPJX,FPJY,FPDIST)                             G0036400
ISN        2                IMPLICIT DOUBLE PRECISION (A-H,K,O-Z)                              G0036410
                      C                                                                           G0036420
ISN        3                INTEGER FPL,FPJX(NFPTMX),FPJY(NFPTMX)                              G0036430
ISN        4                CHARACTER*4 WORD,LAST,FRNT,FPHV(NFPTMX)                            G0036440
ISN        5                LOGICAL COORTR,TRACKF                                              G0036450
ISN        6                DOUBLE PRECISION DX(NXMAX),GLINU1(NU1MAX),GLINU2(NU2MAX)           G0036460
ISN        7                DOUBLE PRECISION BLOKU1(NU1MAX),BLOKU2(NU2MAX),FRNDIS(NU1MAX)      G0036470
ISN        8                DOUBLE PRECISION FPDIST(NFPTMX)                                    G0036480
                      C                                                                           G0036490
ISN        9                CHARACTER*4 HORZ,VERT                                              G0036500
ISN       10                LOGICAL L2SYMM,LCIRCL                                              G0036510
                      C                                                                           G0036520
ISN       11                COMMON/BASICS/ZERO,HALF,ONE,TWO                                    G0036530
ISN       12                COMMON/DIRXNC/HORZ,VERT                                            G0036540
ISN       13                COMMON/PIES  /HALFPI,PI,TWOPI,PI0180                               G0036550
ISN       14                COMMON/LOGSYM/L2SYMM,LCIRCL                                        G0036560
                      C                                                                           G0036570
                      C   ALL PAGES                                                              G0036580
                      C   INPUT  SCALARS: ZERO,NDIMNS,COORTR,TRACKF,NU1MAX,NU2MAX,NDIMNS,       G0036590
                      C                   NFPTMX,HORZ,VERT                                        G0036600
                      C   OUTPUT SCALARS: NU1S,NRFM,NRFP,NU2S,NFPTOT                            G0036610
                      C   OUTPUT  ARRAYS: DX(NXMAX),GLINU1(NU1MAX),GLINU2(NU2MAX),               G0036620
                      C                   BLOKU1(NU1MAX),BLOKU2(NU2MAX),                      G0036630
                      C                   FPHV(NFPTOT),FPJX(NFPTOT),FPJY(NFPTOT),FPDIST(NFPTOT)G0036640
                      C                                                                           G0036650
ISN       15                DATA LAST/'LAST'/,FRNT/'FRNT'/                                     G0036660
                      C                                                                           G0036670
                      C        READ IN THE BLOCK SIZES FOR THE U1-DIRECTION                       G0036680
                      C        IF COORTR IS .TRUE, THEN U1 IS THETA.                              G0036690
                      C        IF COORTR IS FALSE, THEN U1 IS X.                                  G0036700
ISN       16                JU1=1                                                              G0036710
ISN       17                IF (.NOT.COORTR) GLINU1(1)=ZERO                                    G0036720
ISN       19                IF (COORTR) THEN                                                   G0036730
ISN       20                   IF (L2SYMM) THEN                                                G0036740
ISN       21                      JU1=2                                                        G0036750
ISN       22                      GLINU1(2)=-9.0D1                                             G0036760
ISN       23                   ELSE                                                            G0036770
ISN       24                      JU1=1                                                        G0036780
ISN       25                      GLINU1(1)=-1.8D2                                             G0036790
ISN       26                   END IF                                                          G0036800
ISN       27                   READ (2,8004)FRNDIS(JU1)                                        G0036810
ISN       28                   WRITE(6,8004)FRNDIS(JU1)                                        G0036820
ISN       29                   WRITE(9,8004)FRNDIS(JU1)                                        G0036830
ISN       30             8004  FORMAT(18X,D11.4)                                               G0036840
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                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
ISN       31          END IF                                                    G0036850
ISN       32      281 CONTINUE                                                  G0036860
ISN       33          READ (5,8005)NORD,BLOCK,FDIST                             G0036870
ISN       34          WRITE(6,8005)NORD,BLOCK,FDIST                             G0036880
ISN       35          WRITE(9,8005)NORD,BLOCK,FDIST                             G0036890
ISN       36       8005 FORMAT(1X,A4,1X,D11.4,1X,D11.4)                         G0036900
ISN       37          JU1=JU1+1                                                 G0036910
ISN       38          DX(JU1-1)=BLOCK                                           G0036920
ISN       39          BLOKU1(JU1)=BLOCK                                         G0036930
ISN       40          GLINU1(JU1)=GLINU1(JU1-1)+BLOCK                           G0036940
ISN       41          IF (COORTR) FRNDIS(JU1)=FDIST                             G0036950
ISN       43          IF (NORD.NE.LAST) GO TO 281                               G0036960
ISN       44          NU1S=JU1                                                  G0036970
                C     IF (NDIMNS.LT.2) NBLOKS=NX-1 WAS LEFT IN THE MAIN PROGRAM. G0036980
ISN       45          IF (COORTR) THEN                                          G0036990
                C           SET UP FICTITIOUS ANGLES IF L2SYMM IS TRUE.         G0037000
ISN       46            IF (L2SYMM) THEN                                        G0037010
ISN       47              NU1S=JU1+1                                            G0037020
ISN       48              NU1SM1=NU1S-1                                         G0037030
ISN       49              NU1SM2=NU1S-2                                         G0037040
ISN       50              FRNDIS(   1  )=FRNDIS(   3  )                         G0037050
ISN       51              FRNDIS(NU1S)=FRNDIS(NU1SM2)                           G0037060
ISN       52              BLOKU1(   2  )=BLOKU1(   3  )                         G0037070
ISN       53              BLOKU1(NU1S)=BLOKU1(NU1SM1)                           G0037080
ISN       54              GLINU1(   1  )=GLINU1(   2  )+GLINU1(   2  )-GLINU1(   3  ) G0037090
ISN       55              GLINU1(NU1S)=GLINU1(NU1SM1)+GLINU1(NU1SM1)-GLINU1(NU1SM2) G0037100
                C                 OR GLINU1(   1  )=GLINU1(   2  )-BLOKU1(   2  ) G0037110
                C                    GLINU1(NU1S)=GLINU1(NU1SM1)+BLOKU1(NU1S)   G0037120
ISN       56            END IF                                                  G0037130
                C           CONVERT GLINU1 (AND BLOKU1) FROM DEGREES TO RADIANS. G0037140
                C           EVEN IF L2SYMM IS FALSE.                            G0037150
ISN       57            DO 280 JO=1,NU1S                                        G0037160
ISN       58              GLINU1(JO)=GLINU1(JO)*PI0180                          G0037170
ISN       59        280   CONTINUE                                              G0037180
                C           IF L2SYMM IS FALSE, THEN CLOSE THE CIRCLE, AS FOLLOWS: G0037190
ISN       60          END IF                                                    G0037200
                C                                                               G0037210
                C         READ IN THE BLOCK SIZES FOR THE U2-DIRECTION (IF NDIMNS = 2) G0037220
                C         IF COORTR IS  TRUE, THEN U2 IS R.                     G0037230
                C         IF COORTR IS FALSE, THEN U2 IS Y.                     G0037240
ISN       61          JU2=1                                                     G0037250
ISN       62          GLINU2(1)=ZERO                                            G0037260
ISN       63          IF (NDIMNS.LT.2) GO TO 289                                G0037270
ISN       64      285 CONTINUE                                                  G0037280
ISN       65          READ (5,8005)NORD,BLOCK                                   G0037290
ISN       66          WRITE(6,8005)NORD,BLOCK                                   G0037300
ISN       67          WRITE(9,8005)NORD,BLOCK                                   G0037310
ISN       68          IF (NORD.EQ.FRNT) THEN                                    G0037320
ISN       69            NRFN=JU2                                                G0037330
ISN       70            NRFP=NRFN+1                                             G0037340
ISN       71          END IF                                                    G0037350
ISN       72          JU2=JU2+1                                                 G0037360
ISN       73          BLOKU2(JU2)=BLOCK                                         G0037370
ISN       74          GLINU2(JU2)=GLINU2(JU2-1)+BLOCK                           G0037380
ISN       75          IF (NORD.NE.LAST) GO TO 285                               G0037390
ISN       76      289 CONTINUE                                                  G0037400
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                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
ISN       77          NU2S=JU2                                                  G0037410
ISN       78          IF (COORTR) THEN                                          G0037420
                C           NORMALIZE GLINER SO THAT GLINER(NRFN) EQUALS ONE.    G0037430
ISN       79            DO 290 JR=1,NU2S                                        G0037440
ISN       80              GLINU2(JR)=GLINU2(JR)/GLINU2(NRFN)                    G0037450
ISN       81        290   CONTINUE                                              G0037460
ISN       82          END IF                                                    G0037470
                C                                                               G0037480
                C         NXNY=NX*NY  WAS LEFT IN THE MAIN PROGRAM.             G0037490
                C         NXNYAU=NXNY WAS LEFT IN THE MAIN PROGRAM.             G0037500
                C                                                               G0037510
ISN       83          IF (COORTR) THEN                                          G0037520
                C           IF COORTR IS TRUE, THEN OMIT >> ALL << FRONT-POINT DATA. G0037530
ISN       84            NFPTOT=NU1S+NU1S                                        G0037540
ISN       85          ELSE                                                      G0037550
ISN       86            FPL=0                                                   G0037560
ISN       87        292   CONTINUE                                              G0037570
ISN       88              READ (5,80055)J1,NORD,J3,J4,XNUM,J6,DIST              G0037580
ISN       89              WRITE(6,80055)J1,NORD,J3,J4,XNUM,J6,DIST              G0037590
ISN       90              WRITE(9,80055)J1,NORD,J3,J4,XNUM,J6,DIST              G0037600
ISN       91        80055 FORMAT(1X,I2,1X,A4,1X,2I2,F13.9,2X,I2,F15.9)          G0037610
ISN       92              IF (J1.LE.0) GO TO 296                                G0037620
ISN       93              IF (.NOT.TRACKF) GO TO 292                            G0037630
                C             IF TRACKF IS FALSE, READ THE FRONT POINT DATA     G0037640
                C             AND IGNORE THEM.                                  G0037650
ISN       94              FPL=FPL+1                                             G0037660
ISN       95              FPNV(FPL)=NORD                                        G0037670
ISN       96              FPJX(FPL)=J3                                          G0037680
ISN       97              FPJY(FPL)=J4                                          G0037690
ISN       98              FRAC=XNUM                                             G0037700
ISN       99              IF (J6.GE.20) THEN                                    G0037710
ISN      100                FPDIST(FPL)=DIST                                   G0037720
ISN      101              ELSE                                                  G0037730
ISN      102                IF (NORD.EQ.VERT)                                   G0037740
                1             FPDIST(FPL)=GLINU2(J4)+FRAC*(GLINU2(J4+1)-GLINU2(J4)) G0037750
ISN      104                IF (NORD.EQ.HOR)                                    G0037760
                1             FPDIST(FPL)=GLINU1(J3)+FRAC*(GLINU1(J3+1)-GLINU1(J3)) G0037770
ISN      106              END IF                                                G0037780
ISN      107              GO TO 292                                             G0037790
ISN      108        296   CONTINUE                                              G0037800
                C                                                               G0037810
ISN      109              NFPTOT=FPL                                            G0037820
ISN      110            END IF                                                  G0037830
                C                                                               G0037840
ISN      111          RETURN                                                    G0037850
ISN      112          END                                                       G0037860
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STATISTICS SOURCE STATEMENTS = 108, PROGRAM SIZE = 5196 BYTES, PROGRAM NAME = INPUT2 PAGE: 76.

STATISTICS NO DIAGNOSTICS GENERATED.

INPUT2 END OF COMPILATION 13 **********

OPTIONS IN EFFECT: NOLIST NOMAP NOXREF NOGOSTMT NODECK SOURCE TERM NOOBJECT FIXED NOTEST TRMFLG SRCFLG
NOSYM NORENT SDUMP AUTODBL(NONE) NOSXM IL
OPT(0) LANGLVL(77) NOFIPS FLAG(I) NAME(MAIN) LINECOUNT(60) CHARLEN(500)

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                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
                C.INPUT4                                                                G0037870
                CC                                                                      G0037880
                CC   S24.  READ THE TABULAR DATA AND INITIALISE THE IENT'S.             G0037890
                C                                                                       G0037900
ISN        1          SUBROUTINE INPUT4                                                 G0037910
ISN        2          IMPLICIT DOUBLE PRECISION (A-H,K,O-Z)                             G0037920
                C                                                                       G0037930
                CC    INTEGER OIENTI(20),OIENXN(20),OIENSW(20),OIENSL(20) WAS DELETED.  G0037940
                C                                                                       G0037950
ISN        3          LOGICAL COORTR,TRACKF,OVTAKE,DATAFR,RESTRT                        G0037960
                C                                                                       G0037970
ISN        4          COMMON/PRMBLK/SWC,SOIRR,SGIRR,SGPDUM,SWPDUM,KRGDUM,KROG,KROW,     G0037980
                1                KRWDUM,KRODUM,KRGSGD,KROGSG,KROWSW,KRWSWD,KROSGD,     G0037990
                2                KROSWD,PCWDUM,PCVDUM,                                  G0038000
                3                LCTN,IERR,IWRONG                                       G0038010
ISN        5          COMMON/GRIPRO/DT,DXFRNT,DISXN,DX(57),DISTX(58),NFRONT,NBLOKS,     G0038020
                1                NG,NJAY,COORTR,TRACKF,OVTAKE,DATAFR,RESTRT             G0038030
ISN        6          COMMON/STATEV/SWP(55),SGP(55),SOP(55),T(55),P(55),                G0038040
                1                XMOLE(3,55),XO(55),XSOL(55),XN(55)                     G0038050
ISN        7          COMMON/TABLE1/TACTEM(12),TALMUO(12),TALMUW(12),TAMMUG(12),        G0038060
                1                IENTTI(55),NENTTI                                      G0038070
ISN        8          COMMON/TABLE2/TABXN(8),TABUOR(8),IENTXN(55),NENTXN                 G0038080
ISN        9          COMMON/TABLE3/TABSW(16),TABKRW(16),TABKOW(16),TABPCW(16),          G0038090
                1                IENTSW(55),NENTSW                                      G0038100
ISN       10          COMMON/TABLE4/TABSL(18),TABKRG(18),TABKOG(18),TABPCV(18),          G0038110
                1                IENTSL(55),NENTSL                                      G0038120
ISN       11          COMMON/TABLE5/STMTAB(20,6),IENTT2(55),NENTT2                       G0038130
ISN       12          COMMON/ERROR1/ITABL                                               G0038140
ISN       13          COMMON/TABLS1/NBLKS,NGRPS,JGRPOG(50),JAGPOF(9,16),                G0038150
                1                JBLK(55),JFPT(55)                                      G0038160
                C                                                                       G0038170
ISN       14     8020 FORMAT(1X,F6.1,F12.4,2F7.4)                                       G0038180
ISN       15     8021 FORMAT(1X,3F7.4)                                                  G0038190
ISN       16     8022 FORMAT(1X,3F8.5,F8.4)                                             G0038200
ISN       17     8023 FORMAT(1X,F7.3,F13.7,F11.6,F13.7,F11.6,F13.7)                     G0038210
                CC                                                                      G0038220
                CC         TABLE OF VISCOSITIES AS FUNCTION OF TEMPERATURE.             G0038230
                CC            TACTEM: TEMPERATURE (IN FAHRENHEIT).                      G0038240
                CC            TALMUO: VISCOSITY OF THE HYDROCARBON PHASE (IN CENTIPOISE). G0038250
                CC            TALMUW: VISCOSITY OF THE WATER PHASE  (IN CENTIPOISE).    G0038260
                CC            TAMMUG: VISCOSITY OF THE VAPOUR PHASE (IN CENTIPOISE).    G0038270
                CC         ALTHOUGH TALMUO IS READ IN, IT IS NOT NECESSARILY USED.      G0038280
                C                                                                       G0038290
ISN       18          IE=0                                                              G0038300
ISN       19     10020 CONTINUE                                                         G0038310
ISN       20          IE=IE+1                                                           G0038320
ISN       21          READ (5,8020)TACTEM(IE),TALMUO(IE),TALMUW(IE),TAMMUG(IE)          G0038330
ISN       22          WRITE(6,8020)TACTEM(IE),TALMUO(IE),TALMUW(IE),TAMMUG(IE)          G0038340
ISN       23          WRITE(9,8020)TACTEM(IE),TALMUO(IE),TALMUW(IE),TAMMUG(IE)          G0038350
ISN       24          IF (TACTEM(IE).GT.1.0D-4) GO TO 10020                             G0038360
ISN       25          NENTTI=IE-1                                                       G0038370
                C                                                                       G0038380
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                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
ISN       26          DO 10030 IE=1,NENTTI                                              G0038390
                C  CONVERT FROM FAHRENHEIT TO KELVIN, THEN TAKE THE LOGARITHM           G0038400
                C  TO MAKE INTERPOLATION EASIER.                                        G0038410
ISN       27          TACTEM(IE)=DLOG(((TACTEM(IE)-32.0D0)/1.8D0) + 273.15D0)           G0038420
                C  CONVERT FROM CENTIPOISE TO MKS UNITS, THEN TAKE THE LOGARITHM        G0038430
                C  TO MAKE INTERPOLATION EASIER.                                        G0038440
ISN       28          TALMUO(IE)=DLOG(TALMUO(IE)*1.0D-03)                               G0038450
ISN       29          TALMUW(IE)=DLOG(TALMUW(IE)*1.0D-03)                               G0038460
ISN       30          TAMMUG(IE)=DLOG(TAMMUG(IE)*1.0D-03)                               G0038470
ISN       31     10030 CONTINUE                                                         G0038480
                CC                                                                      G0038490
                CC         TABLE OF COMPOSITION-DEPENDENT PROPERTIES.                   G0038500
                CC                                                                      G0038510
                CC            TABXN: MOLE FRACTION OF THE NON-VOLATILE HYDROCARBON.     G0038520
                CC           TABUOR: COATS'S VISCOSITY-MODIFICATION FACTOR.             G0038530
                C                                                                       G0038540
ISN       32          IE=0                                                              G0038550
ISN       33     10021 CONTINUE                                                         G0038560
ISN       34          IE=IE+1                                                           G0038570
ISN       35          READ (5,8021)TABXN(IE),TABUOR(IE)                                 G0038580
ISN       36          WRITE(6,8021)TABXN(IE),TABUOR(IE)                                 G0038590
ISN       37          WRITE(9,8021)TABXN(IE),TABUOR(IE)                                 G0038600
ISN       38          IF (TABXN(IE).GT.1.0D-4) GO TO 10021                              G0038610
ISN       39          NENTXN=IE-1                                                       G0038620
                CC                                                                      G0038630
                CC         TABLE OF KRW, KROW, AND PCW AS A FUNCTION OF SWP.            G0038640
                CC                                                                      G0038650
                CC            TABSW : THE WATER-PHASE SATURATION.                       G0038660
                CC           TABKRW: THE 2-PHASE WATER-PHASE RELATIVE PERMEABILITY      G0038670
                CC           TABKOW: THE 2-PHASE HYDROCARBON-PHASE RELATIVE PERMEABILITY G0038680
                CC                   WITH RESPECT TO THE WATER PHASE.                   G0038690
                CC           TABPCW: THE 2-PHASE WATER-PHASE CAPILLARY PRESSURE.        G0038700
                CC                                                                      G0038710
                CC         THE KR VS. SWP TABLE MUST BE EXTENDED DEEP INTO THE REGION   G0038720
                CC         WHERE SWP IS SMALLER THAN SWC.  KRWP MAY BE SET TO ZERO,     G0038730
                CC         BUT KROW SHOULD BE SET TO A VALUE SUCH THAT THE              G0038740
                CC         KROW VS. SWP CURVE REMAINS CONVEX.                           G0038750
                CC         THEREFORE, 1.0 IS A POOR CHOICE FOR KROW,                    G0038760
                CC         BUT 2.0 OR 3.0 MIGHT BE A GOOD CHOICE FOR KROW.              G0038770
                C                                                                       G0038780
ISN       40          IE=0                                                              G0038790
ISN       41     10022 CONTINUE                                                         G0038800
ISN       42          IE=IE+1                                                           G0038810
ISN       43          READ (5,8022)TABSW(IE),TABKRW(IE),TABKOW(IE),TABPCW(IE)           G0038820
ISN       44          WRITE(6,8022)TABSW(IE),TABKRW(IE),TABKOW(IE),TABPCW(IE)           G0038830
ISN       45          WRITE(9,8022)TABSW(IE),TABKRW(IE),TABKOW(IE),TABPCW(IE)           G0038840
ISN       46          IF (TABSW(IE).GT.1.0D-4) GO TO 10022                              G0038850
ISN       47          NENTSW=IE-1                                                       G0038860
                C                                                                       G0038870
ISN       48          ONEPSI=6894.76D0                                                  G0038880
                C  ONEPSI IS 6894.76 PASCALS.                                           G0038890
ISN       49          DO 10032 IE=1,NENTSW                                              G0038900
                C  CONVERT FROM PSIA TO PASCALS (M.K.S.)                                G0038910
ISN       50          TABPCW(IE)=ONEPSI*TABPCW(IE)                                      G0038920
ISN       51     10032 CONTINUE                                                         G0038930
                C                                                                       G0038940
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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
                C         TABLE OF KRG, KROG, AND PCV AS A FUNCTION OF SLP.                    G0038950
                C                                                                              G0038960
                C            TABSL:  THE COMBINED SATURATION OF THE LIQUID PHASES.             G0038970
                C            TABKRG: THE 2-PHASE VAPOUR-PHASE RELATIVE PERMEABILITY            G0038980
                C            TABKOG: THE 2-PHASE HYDROCARBON-PHASE RELATIVE PERMEABILITY       G0038990
                C                    WITH RESPECT TO THE VAPOUR PHASE.                         G0039000
                C            TABPCV: THE 2-PHASE VAPOUR-PHASE CAPILLARY PRESSURE.              G0039010
                C                                                                              G0039020
ISN       52          IE=0                                                                     G0039030
ISN       53    10023 CONTINUE                                                                 G0039040
ISN       54          IE=IE+1                                                                  G0039050
ISN       55          READ (5,8022)TABSL(IE),TABKRG(IE),TABKOG(IE),TABPCV(IE)                  G0039060
ISN       56          WRITE(6,8022)TABSL(IE),TABKRG(IE),TABKOG(IE),TABPCV(IE)                  G0039070
ISN       57          WRITE(9,8022)TABSL(IE),TABKRG(IE),TABKOG(IE),TABPCV(IE)                  G0039080
ISN       58          IF (TABSL(IE).GT.1.0D-4) GO TO 10023                                     G0039090
ISN       59          NENTSL=IE-1                                                              G0039100
                C                                                                              G0039110
ISN       60          DO 10033 IE=1,NENTSL                                                     G0039120
                C  CONVERT FROM PSIA TO PASCALS (M.K.S.)                                       G0039130
ISN       61          TABPCV(IE)=ONEPSI*TABPCV(IE)                                             G0039140
ISN       62    10033 CONTINUE                                                                 G0039150
                C                                                                              G0039160
                C         TABLE OF STEAM PROPERTIES AS A FUNCTION OF STEAM TEMPERATURE.        G0039170
                C                                                                              G0039180
                C          COLUMN  1  =   STEAM  TEMPERATURE          ( F )                   G0039190
                C                  2  =   SATURATED  STEAM  PRESSURE  ( PSIA )                G0039200
                C                  3  =   1/DENSITY  OF  SAT'D  LIQUID ( FT3/LB )             G0039210
                C                  4  =   1/DENSITY  OF  SAT'D  VAPOUR (  "  )                G0039220
                C                  5  =   ENTHALPY   OF  SAT'D  LIQUID ( BTU/LB )             G0039230
                C                  6  =   ENTHALPY   OF  SAT'D  VAPOUR (  "  )                G0039240
                C                                                                              G0039250
                C                                                                              G0039260
ISN       63          IE=0                                                                     G0039270
ISN       64    10044 CONTINUE                                                                 G0039280
ISN       65          IE=IE+1                                                                  G0039290
ISN       66          READ(5,8023) (STMTAB(IE,J),J=1,6)                                        G0039300
ISN       67          WRITE(6,8023)(STMTAB(IE,J),J=1,6)                                        G0039310
ISN       68          WRITE(9,8023)(STMTAB(IE,J),J=1,6)                                        G0039320
ISN       69          IF (STMTAB(IE,1).GT.1.0D-4) GO TO 10044                                  G0039330
ISN       70          NENTT2=IE-1                                                              G0039340
ISN       71          DO 10045 IE=1,NENTT2                                                     G0039350
                C            CONVERT                                                           G0039360
ISN       72           STMTAB(IE,1)=(STMTAB(IE,1)-32.0D0)/1.8D0                                G0039370
ISN       73           STMTAB(IE,2)=STMTAB(IE,2)*ONEPSI                                        G0039380
ISN       74           STMTAB(IE,3)=1.D3/62.4D0/STMTAB(IE,3)/18.D0                             G0039390
ISN       75           STMTAB(IE,4)=1.D3/62.4D0/STMTAB(IE,4)/18.D0                             G0039400
ISN       76              BTULB=(1.000/1.8D0)*4.186D3*18.D0                                    G0039410
ISN       77              STMTAB(IE,5)=STMTAB(IE,5)*BTULB                                      G0039420
ISN       78              STMTAB(IE,6)=STMTAB(IE,6)*BTULB                                      G0039430
ISN       79    10045 CONTINUE                                                                 G0039440
                C                                                                              G0039450
                C            INITIALISE IENTTI,IENTXN,IENTSN,IENTSL.                           G0039460
                C            THE SUBROUTINE TABENT CALCULATES WHAT THEY SHOULD BE.             G0039470
ISN       80          DO 301 I=1,NGRPS                                                         G0039480
ISN       81             IENTTI(I)=1                                                           G0039490
ISN       82             IENTXN(I)=1                                                           G0039500
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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
ISN       83             IENTSN(I)=1                                                           G0039510
ISN       84             IENTSL(I)=1                                                           G0039520
ISN       85             IENTT2(I)=1                                                           G0039530
ISN       86        301 CONTINUE                                                               G0039540
ISN       87          ITABL=0                                                                  G0039550
ISN       88          RETURN                                                                   G0039560
ISN       89          END                                                                      G0039570
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STATISTICS SOURCE STATEMENTS = 89, PROGRAM SIZE = 5852 BYTES, PROGRAM NAME = INPUT4 PAGE: 79.

STATISTICS NO DIAGNOSTICS GENERATED.

INPUT4 END OF COMPILATION 14 ******

OPTIONS IN EFFECT: NOLIST NOMAP NOXREF NOGOSTMT NODECK SOURCE TERM NOOBJECT FIXED NOTEST TRMFLG SRCFLG
NOSYM NORENT SDUMP AUTODBL(NONE) NOSXM IL
OPT(0) LANGLVL(77) NOFIPS FLAG(I) NAME(MAIN) LINECOUNT(60) CHARLEN(500)

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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
                C INPUT5                                                                          G0039580
                C                                                                                 G0039590
                C  S25.  READ THE STATE VARIABLES.                                                G0039600
                C                                                                                 G0039610
ISN         1       SUBROUTINE INPUT5(NWELMX,NDIRMX,NGRPMX)                                       G0039620
ISN         2       IMPLICIT DOUBLE PRECISION (A-H,K,O-Z)                                         G0039630
                C                                                                                 G0039640
ISN         3       LOGICAL EXTRVS,LREGLR                                                         G0039650
ISN         4       LOGICAL LDUM1,LDUM2                                                           G0039660
ISN         5       CHARACTER*4 LLAST,LAST                                                        G0039670
                C                                                                                 G0039680
ISN         6       LOGICAL EQHAO1,EQHA10,VOUCPT,VOUCSC,EQUIL                                     G0039690
ISN         7       LOGICAL COORTR,TRACKF,OVTAKE,DATAFR,RESTRT                                    G0039700
ISN         8       LOGICAL OUT,REPEAT,JCTEST,JTINIT,ITERPR,BYWEIT                                G0039710
ISN         9       DOUBLE PRECISION MOBGL,MOBWL,MOBOL,MOBTL                                      G0039720
ISN        10       LOGICAL RCONDL                                                                G0039730
ISN        11       CHARACTER*4 HORZ,VERT                                                         G0039740
ISN        12       INTEGER FPJX,FPJY                                                             G0039750
ISN        13       CHARACTER*4 FPHV                                                              G0039760
ISN        14       LOGICAL LFRNT                                                                 G0039770
ISN        15       LOGICAL LBNDOG,LBNDB                                                          G0039780
ISN        16       LOGICAL RCOND,INJECT                                                          G0039790
ISN        17       LOGICAL LNEWNR,LWELL                                                          G0039800
                C                                                                                 G0039810
ISN        18       COMMON/PRMBLK/SMC,SOIRR,SGIRR,SGPDUM,SWPDUM,KRGDUM,KROG,KROW,                 G0039820
                1                KRWDUM,KRODUM,KRGSGD,KROGSG,KROWSM,KRWSWD,KROSGD,             G0039830
                2                KROSWD,PCWDUM,PCVDUM,                                          G0039840
                3                LCTN,IERR,IWRONG                                               G0039850
ISN        19       COMMON/PVAPOR/PWAT(55),POIL(55),PSOL(55),DPWAT(55),DPOIL(55),                 G0039860
                1               DPSOL(55),DPDT(55),YMOLE(4,55),YO(55),YV(55),YS(55)            G0039870
ISN        20       COMMON/EQLBRM/PEQUIL,                                                         G0039880
                1               EQHAO1,EQHA10,VOUCPT,VOUCSC,EQUIL(55)                          G0039890
ISN        21       COMMON/VPCONS/AW,BW,AO,BO,CO,ASOL,BSOL,CSOL,TO(55)                            G0039900
ISN        22       COMMON/INJSPC/PGRDNT,TOTINJ,VAPINJ(28),HCBINJ(28),WATINJ(28),                 G0039910
                1               VLCTY,HC1INJ(28),HC2INJ(28),HC3INJ(28),                        G0039920
                2               VO1INJ(28),VO2INJ(28),VWAINJ(28)                               G0039930
ISN        23       COMMON/GRIPRO/DT,DXFRNT,DISXM,DX(57),DISTX(58),NFRONT,NBLOKS,                 G0039940
                1               NG,NJAY,COORTR,TRACKF,OVTAKE,DATAFR,RESTRT                     G0039950
ISN        24       COMMON/LOGNIS/OUT,REPEAT,JCTEST,JTINIT,ITERPR,BYWEIT                          G0039960
ISN        25       COMMON/STATEV/SWP(55),SGP(55),SOP(55),T(55),P(55),                            G0039970
                1               XMOLE(3,55),XO(55),XSOL(55),XW(55)                             G0039980
ISN        26       COMMON/INJCND/RATEL,PSPECL,MOBGL,MOBWL,MOBOL,MOBTL,                           G0039990
                1               AINJV,TSPECL,                                                  G0040000
                2               RCONDL                                                         G0040010
ISN        27       COMMON/CWDENS/R(55),D(55),V(55)                                               G0040020
ISN        28       COMMON/TABLE1/TACTEM(12),TALMUO(12),TALMUW(12),TAMBUG(12),                    G0040030
                1               IENTT(55),NENTTI                                               G0040040
ISN        29       COMMON/TABLE2/TABXW(8),TABUOR(8),IENTXN(55),NENTXN                            G0040050
ISN        30       COMMON/TABLE3/TABSM(16),TABKRM(16),TABKOW(16),TABPCW(16),                     G0040060
                1               IENTSW(55),NENTSW                                              G0040070
ISN        31       COMMON/TABLE4/TABSL(18),TABKRG(18),TABKOG(18),TABPCV(18),                     G0040080
                1               IENTSL(55),NENTSL                                              G0040090
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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
ISN        32       COMMON/ERRORT/ITABL                                                           G0040100
ISN        33       COMMON/BASICS/ZERO,HALF,ONE,TWO                                               G0040110
ISN        34       COMMON/IBASCS/NULL                                                            G0040120
ISN        35       COMMON/DIMENS/NDIMNS,NX,NY,NOS,NRS,NRFM,NRFP                                  G0040130
ISN        36       COMMON/DIRXNC/HORZ,VERT                                                       G0040140
ISN        37       COMMON/FRONT1/NFPTOT,FPJX(16),FPJY(16)                                        G0040150
ISN        38       COMMON/FRONT2/FPHV(16)                                                        G0040160
ISN        39       COMMON/FRONT3/FPDIST(16),FPDISX(16),FPDISY(16),FPDSNM(16)                     G0040170
ISN        40       COMMON/TABLS1/NBLKS,NGRPS,JGRPOG(50),JAGPOF(9,16),                            G0040180
                1               JBLK(55),JFPT(55)                                              G0040190
ISN        41       COMMON/TABL1A/LFRNT(55)                                                       G0040200
ISN        42       COMMON/BTBLS1/NBNDBS,JBNDOG(55),JBNDB(50),JBLKOB(28),JINTOB(28)               G0040210
ISN        43       COMMON/BTBL1A/LBNDOG(55),LBNDB(50)                                            G0040220
ISN        44       COMMON/SPEC3 /TSPEC(28),PSPEC(28),FSPEC(28)                                   G0040230
ISN        45       COMMON/SPEC4 /RCOND(28),INJECT(28)                                            G0040240
ISN        46       COMMON/BVOLFL/BVFLOW(28),FLFR(150)                                            G0040250
ISN        47       COMMON/IJTBIJ/IOFGRP(55),JOFGRP(55),JGRPIJ(36,24)                             G0040260
ISN        48       COMMON/TABLS2/NRLGS,JGRPOF(16),JRLG(55),JGRPOR(54),                           G0040270
                1               JGPTNR(55),JTYFRN(55),JTYRFL(55),JRFLIN(55)                    G0040280
ISN        49       COMMON/WELLXY/XWELL(11),YWELL(11)                                             G0040290
ISN        50       COMMON/WELLJ1/NWELLS,IENTWO(11),IENTWR(11),JGNEAR(11),                        G0040300
                1               JWELOG(55)                                                     G0040310
ISN        51       COMMON/WELLJ2/JGPSC(8,11)                                                     G0040320
ISN        52       COMMON/WELLLG/LNEWNR(11),LWELL(55)                                            G0040330
                CCCCCC                                                                            G0040340
                CCCCCC ALL PAGES                                                                  G0040350
                CCCCCC INPUT  SCALARS: NGRPS,RESTRT,NULL,SGIRR,NFPTOT,ONE,ZERO,NJAY,NDIMNS      G0040360
                CCCCCC OUTPUT SCALARS: NBNDBS,IERR                                              G0040370
                CCCCCC INPUT   ARRAYS: JBLK,FPHV,FPJX,FPJY,FPDISX,FPDISY,GLINEX,GLINEY,         G0040380
                CCCCCC                 JGRPOG,JAGPOF                                            G0040390
                CCCCCC OUTPUT  ARRAYS: LBNDB,P,T,XMOLE,SWP,SGP,SOP,JBNDB,                      G0040400
                CCCCCC                 JBLKOB,RCOND,INJECT,JINTOB,TSPEC,FSPEC,PSPEC,           G0040410
                CCCCCC                 BVFLOW,R,D,V,WATINJ,HCBINJ,VAPINJ                       G0040420
                CCCCCC                 HC1INJ,HC2INJ,HC3INJ,VO1INJ,VO2INJ,VWAINJ               G0040430
ISN        53       DATA LAST/'LAST'/                                                             G0040440
                C                                                                                 G0040450
ISN        54       IERR=0                                                                        G0040460
ISN        55       JBNDBJ=0                                                                      G0040470
ISN        56       NWELLS=0                                                                      G0040480
                C                                                                                 G0040490
ISN        57       DO 301 J=1,NGRPS                                                              G0040500
ISN        58          JGRPJ=J                                                                    G0040510
ISN        59          JBLKJ=JBLK(J)                                                              G0040520
ISN        60          IF (COORTR) LREGLR=(JTYRFL(J).NE.4)                                        G0040530
ISN        62          IF (.NOT.COORTR) LREGLR=(JBLKJ.GT.NULL)                                    G0040540
ISN        64          IF (RESTRT.OR.LREGLR) THEN                                                 G0040550
                CCCCCCC                                                                           G0040560
                CCCCCCC        LDUM1 - SEE THE EXPLANATION BELOW.                                 G0040570
                CCCCCCC        IDUM1 - NOT USED IN THE CURRENT VERSION OF THE SIMULATOR.          G0040580
                CCCCCCC           P - PRESSURE.                                                   G0040590
                CCCCCCC           T - TEMPERATURE.                                                G0040600
                CCCCCCC                                                                           G0040610
                C                                                                                 G0040620
ISN        65          READ (5,80110)LDUM1,IDUM1,P(J),T(J)                                        G0040630
ISN        66          WRITE(6,80110)LDUM1,IDUM1,P(J),T(J)                                        G0040640
ISN        67          WRITE(9,80110)LDUM1,IDUM1,P(J),T(J)                                        G0040650
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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
                C                                                                              G0040660
                C                 LDUM2 - NOT USED IN THE CURRENT VERSION OF THE SIMULATOR.    G0040670
                C                 XMOLE - MOLE FRACTION IN THE HYDROCARBON PHASE.              G0040680
                C                         1: VOLATILE COMPONENT #1, E.G. METHANE.              G0040690
                C                         2: VOLATILE COMPONENT #2, E.G. SOLVENT.              G0040700
                C                         3: NON-VOLATILE COMPONENT, E.G. BITUMEN.             G0040710
                C                   SWP -  WATER-PHASE SATURATION.                             G0040720
                C                   SGP - VAPOUR-PHASE SATURATION.                             G0040730
                C                                                                              G0040740
ISN       68                    READ (5,80111)LDUM2,XMOLE(1,J),XMOLE(2,J),SWP(J),SGP(J)      G0040750
ISN       69                    WRITE(6,80111)LDUM2,XMOLE(1,J),XMOLE(2,J),SWP(J),SGP(J)      G0040760
ISN       70                    WRITE(9,80111)LDUM2,XMOLE(1,J),XMOLE(2,J),SWP(J),SGP(J)      G0040770
ISN       71   80110            FORMAT(1X,L1,I1,5D13.6)                                       G0040780
ISN       72   80111            FORMAT(1X,L1,1X,5D13.6)                                       G0040790
ISN       73                    IF (LDUM1) THEN                                               G0040800
                C                    IF COORTR IS TRUE, THEN LDUM1 IS EXPECTED TO BE          G0040810
                C                    ALWAYS FALSE.                                            G0040820
                C                    IF LDUM1 IS FALSE, THEN (EVENTUALLY)                     G0040830
                C                    LBNDOG(JGRPJ) AND JBNDOG(JGRPJ) WILL BE SET              G0040840
                C                       TO .FALSE. AND NULL, RESPECTIVELY.                    G0040850
                C                    LBNDB (JBLKJ) AND JBNDB (JBLKJ) WILL ALSO BE SET         G0040860
                C                       TO .FALSE. AND NULL, RESPECTIVELY,                    G0040870
                C                       PROVIDED THAT JBLKJ IS NOT NULL.                      G0040880
                C                    THE ARRAY LBNDOG IS USED EVEN IF COORTR IS TRUE.          G0040890
ISN       74                       JBNDBJ=JBNDBJ+1                                           G0040900
ISN       75                       LBNDB(JBLKJ)=.TRUE.                                       G0040910
ISN       76                       JBNDB(JBLKJ)=JBNDBJ                                       G0040920
ISN       77                       JBLKOB(JBNDBJ)=JBLKJ                                      G0040930
ISN       78                       LBNDOG(JGRPJ)=.TRUE.                                      G0040940
ISN       79                       JBNDOG(JGRPJ)=JBNDBJ                                      G0040950
                C                                                                              G0040960
                C                    NEXT, READ THE BOUNDARY CONDITIONS.                       G0040970
                C                                                                              G0040980
                C                    RCOND  - T MEANS THAT THE FLOW RATE IS SPECIFIED.         G0040990
                C                           - F MEANS THAT THE  PRESSURE IS SPECIFIED.         G0041000
                C                    INJECT - T MEANS THAT INJECTION RATIOS ARE INCLUDED       G0041010
                C                             IN THE DATA. IT DOES NOT NECESSARILY MEAN        G0041020
                C                             THAT THE BLOCK IS AN INJECTION BLOCK AT          G0041030
                C                             THE INITIAL TIME.                                G0041040
                C                           - F MEANS THAT THE INJECTION RATIOS ARE            G0041050
                C                             MEANINGLESS BECAUSE THE BLOCK IS NEVER           G0041060
                C                             AN INJECTION BLOCK.                              G0041070
                C                    JINTOB - SEE THE DESCRIPTION OF THE TABLES.               G0041080
                C                    TSPEC  - SPECIFIED TEMPERATURE.                           G0041090
                C                    PSPEC  - SPECIFIED PRESSURE.                              G0041100
                C                    FSPEC  - SPECIFIED FLOW RATE.                             G0041110
                C                    BSPEC  - EITHER PSPEC OR FSPEC DEPENDING ON RCOND.        G0041120
                C                    BVFLOW - BOUNDARY (TOTAL VOLUMETRIC) FLOW RATE.           G0041130
                C                             POSITIVE BVFLOW MEANS THAT THE FLOW IS INTO      G0041140
                C                             THE RESERVOIR.                                   G0041150
                C                                                                              G0041160
                C                    RCOND  EQUIL  BOUNDARY CONDITIONS SPECIFIED               G0041170
                C                      T      T      FLOW(,TEMPERATURE)                       G0041180
                C                      T      F      FLOW,TEMPERATURE                         G0041190
                C                      F      T      PRESSURE(,TEMPERATURE)                   G0041200
                C                      F      F      PRESSURE,TEMPERATURE                     G0041210
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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
                C                    (1) IF VAPOUR IS PRESENT, IT IS NOT NECESSARY TO          G0041220
                C                        PROVIDE THE EXACT BOUNDARY TEMPERATURES: THEY WILL    G0041230
                C                        BE RECALCULATED.                                      G0041240
                C                    (2) WHETHER OR NOT VAPOUR IS PRESENT, DON'T BOTHER        G0041250
                C                        PROVIDING A VALUE FOR BVFLOW.  BVFLOW IS A NUMBER     G0041260
                C                        WHICH THE COMPUTER STORES AND READS FOR THE           G0041270
                C                        PURPOSE OF RESTARTING A SIMULATION.                   G0041280
                C                                                                              G0041290
                C                                                                              G0041300
ISN       80                       JARG=J                                                    G0041310
ISN       81                       CALL INPT5B(JBNDBJ,.TRUE.,JARG)                           G0041320
                C                       I.E. CALL SUBROUTINE INPT5B(JBNDBJ,JKWOMN,J)           G0041330
                C                                                                              G0041340
ISN       82                       IF (INJECT(JBNDBJ)) THEN                                  G0041350
                C                       I DECIDED NOT TO SET XMOLE AND YMOLE                   G0041360
                C                       TO THE CORRESPONDING INJECTION RATIOS                  G0041370
                C                       (WHICH ARE READ IN BY THE SUBROUTINE INPT5B).          G0041380
                C                                                                              G0041390
                C                       THESE CALCULATIONS WILL BE PERFORMED LATER FOR         G0041400
                C                       EVERY GROUP, INCLUDING THESE                           G0041410
                C                       INJECT'N BOUNDARY BLOCK GROUPS.                        G0041420
ISN       83                          XMOLE(3,J)=ONE-XMOLE(1,J)-XMOLE(2,J)                   G0041430
ISN       84                          EQUIL(J)=(VAPINJ(JBNDBJ).GT.SGIRR)                     G0041440
                C                                                                              G0041450
ISN       85                          JARG=J                                                 G0041460
ISN       86                          IF (EQUIL(JARG))                                       G0041470
                1                        CALL VPTEMP(JARG,.FALSE.,.TRUE.,.TRUE.,.FALSE.,    G0041480
                2                                    LCTN,NGRPMX,P,XMOLE,                   G0041490
                3                                    PEQUIL,T,PHAT,POIL,PSOL,               G0041500
                4                                    DPHAT,DPOIL,DPSOL,IERR,IWRONG)         G0041510
                C                          I.E. CALL VPTEMP(IPARM,NORMAL,TCHNGE,DERIVS,LHALF, G0041520
                C                                           LCTN,NGRPMX,P,XMOLE,               G0041530
                C                                           PEQUIL,T,PHAT,POIL,PSOL,           G0041540
                C                                           DPHAT,DPOIL,DPSOL,IERR,IWRONG)     G0041550
ISN       88                          IF (IERR.NE.0) STOP                                    G0041560
                C                                                                              G0041570
ISN       90                          JARG=J                                                 G0041580
ISN       91                          CALL SATS(JARG,JBNDBJ)                                 G0041590
                C                          I.E. CALL SUBROUTINE SATS(J,JBNDBJ).                G0041600
                C                                                                              G0041610
ISN       92                          WRITE(9,8016)                                          G0041620
ISN       93    8016                  FORMAT('1',' OUTPUT FROM  SATS WAS OMITTED'/' 0')      G0041630
ISN       94                          IF (IERR.NE.0) GO TO 230                               G0041640
ISN       95                          WRITE(6,343)                                           G0041650
ISN       96                          WRITE(9,343)                                           G0041660
ISN       97                          WRITE(6,344)SGP(J),SOP(J),SWP(J)                       G0041670
ISN       98                          WRITE(9,344)SGP(J),SOP(J),SWP(J)                       G0041680
ISN       99     343                  FORMAT(' SATURATIONS:   GAS       OIL      WATER ')    G0041690
ISN      100     344                  FORMAT(' SATS',8X,3F9.6)                               G0041700
ISN      101                       END IF                                                    G0041710
ISN      102                    ELSE                                                         G0041720
                C                    LDUM1 IS FALSE - THEREFORE,                               G0041730
                C                    J IS NOT A BOUNDARY BLOCK GROUP.                          G0041740
                C                    (IF COORTR IS TRUE, THE CONCEPT                           G0041750
                C                    OF BOUNDARY BLOCK GROUPS IS NOT USED;                     G0041760
                C                    THEREFORE, J IS NEVER A BOUNDARY BLOCK GROUP.)            G0041770
```

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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
ISN     103                   LBNDOG(JGRPJ)=.FALSE.                                          G0041780
ISN     104                   JBNDOG(JGRPJ)=NULL                                             G0041790
ISN     105                   IF (JBLKJ.GT.NULL) THEN                                        G0041800
ISN     106                     LBNDB(JBLKJ)=.FALSE.                                         G0041810
ISN     107                     JBNDB(JBLKJ)=NULL                                            G0041820
ISN     108                   END IF                                                         G0041830
ISN     109                 END IF                                                           G0041840
ISN     110               ELSE                                                             G0041850
C                           IF THE PROGRAM BRANCHES TO HERE, IT FOLLOWS THAT               G0041860
C                           IF COORTR IS FALSE, J IS NOT A BLOCK GROUP.  WHILE             G0041870
C                           IF COORTR IS  TRUE, J IS A FICTITIOUS GROUP.                   G0041880
ISN     111                 LBNDOG(JGRPJ)=.FALSE.                                          G0041890
ISN     112                 JBNDOG(JGRPJ)=NULL                                             G0041900
ISN     113               END IF                                                           G0041910
ISN     114             IF (JTYRFL(J).EQ.2) THEN                                         G0041920
C                         COPY THE VALUES TO THE APPROPRIATE FICTITIOUS GROUP.           G0041930
ISN     115               JIMAGE=JRFLIM(J)                                               G0041940
ISN     116               P(JIMAGE)=P(J)                                                 G0041950
ISN     117               T(JIMAGE)=T(J)                                                 G0041960
ISN     118               SMP(JIMAGE)=SMP(J)                                             G0041970
ISN     119               SGP(JIMAGE)=SGP(J)                                             G0041980
ISN     120               XMOLE(1,JIMAGE)=XMOLE(1,J)                                     G0041990
ISN     121               XMOLE(2,JIMAGE)=XMOLE(2,J)                                     G0042000
ISN     122             END IF                                                           G0042010
ISN     123   301 CONTINUE                                                               G0042020
C                                                                                        G0042030
ISN     124       IF (COORTR) THEN                                                       G0042040
ISN     125         IWELL=0                                                              G0042050
ISN     126   251   CONTINUE                                                            G0042060
ISN     127         IWELL=IWELL+1                                                        G0042070
C                                                                                        G0042080
C                     LLAST - T MEANS THIS IS THE LAST WELL.                             G0042090
C                             F MEANS THERE ARE MORE WELLS.                              G0042100
C                     XWELL - X-LOCATION OF THE WELL.                                    G0042110
C                     YWELL - Y-LOCATION OF THE WELL.                                    G0042120
ISN     128               READ (5,80105)LLAST,XWELL(IWELL),YWELL(IWELL)                  G0042130
ISN     129               WRITE(6,80105)LLAST,XWELL(IWELL),YWELL(IWELL)                  G0042140
ISN     130               WRITE(9,80105)LLAST,XWELL(IWELL),YWELL(IWELL)                  G0042150
ISN     131   80105       FORMAT(1X,A4,2F8.2)                                            G0042160
ISN     132               IENTNO(IWELL)=1                                                G0042170
ISN     133               IENTNR(IWELL)=1                                                G0042180
ISN     134               JGNEAR(IWELL)=NULL                                             G0042190
C                                                                                        G0042200
C                     SOME OF THE CALCULATIONS IN SRCUPD WILL BE WASTED.                 G0042210
C                     JGNEAR(IWELL) IS THE ONLY NUMBER WHICH IS NEEDED HERE.             G0042220
ISN     135               CALL SRCUPD(.FALSE.,.TRUE.,.TRUE.,IWELL,IWELL,                 G0042230
                1                 NWELMX,NDIRMX,NGRPMX,                                  G0042240
                2                 LNEMNR,LWELL,JGNEAR,JWELOG,                            G0042250
                3                 IENTNO,IENTNR,JGPSC,                                   G0042260
                4                 ITABL,IERR)                                            G0042270
C                     I.E. CALL SRCUPD(ALWELS,LCNEAR,LCIENT,IWLSTA,IWLFIN,               G0042280
C                                      NWELMX,NDIRMX,NGRPMX,                             G0042290
C                                      LNEMNR,LWELL,JGNEAR,JWELOG,                       G0042300
C                                      IENTNO,IENTNR,JGPSC,                              G0042310
C                                      ITABL,IERR)                                       G0042320
                                                                                         G0042330
```



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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
C                                                                                        G0042340
ISN     136       CALL INPT5B(IWELL,.TRUE.,JGNEAR(IWELL))                                G0042350
C                   I.E. CALL SUBROUTINE INPT5B(JBNDBJ,JKNOWN,J)                         G0042360
C                                                                                        G0042370
ISN     137       IF (LLAST.NE.LAST) GO TO 251                                           G0042380
C                                                                                        G0042390
ISN     138       NWELLS=IWELL                                                           G0042400
C                                                                                        G0042410
ISN     139       END IF                                                                 G0042420
C                                                                                        G0042430
ISN     140     NBNDBS=JBNDBJ+NWELLS                                                     G0042440
C                                                                                        G0042450
ISN     141     IF (.NOT.RESTRT.AND..NOT.COORTR) THEN                                    G0042460
C                 TWO TASKS:                                                             G0042470
C                 1) INTERPOLATE FOR THE FRONT POINTS (IF ANY).                          G0042480
C                 2) EXTRAPOLATE FOR NJAY (IF NDIMNS=1).                                 G0042490
C                                                                                        G0042500
C                 1) INTERPOLATE FOR THE FRONT POINTS (IF ANY).                          G0042510
ISN     142         IF (NFPTOT.GT.0) THEN                                                G0042520
ISN     143           LDUM1=.FALSE.                                                      G0042530
C                                                                                        G0042540
ISN     144           DO 311 JFP=1,NFPTOT                                                G0042550
ISN     145             JX=FPJX(JFP)                                                     G0042560
ISN     146             JY=FPJY(JFP)                                                     G0042570
ISN     147             IF (FPHV(JFP).EQ.HORZ) THEN                                      G0042580
ISN     148               JBLNEG=(JY-1)*NX+JX                                            G0042590
ISN     149               JBLPOS=JBLNEG+1                                                G0042600
ISN     150             END IF                                                           G0042610
ISN     151             IF (FPHV(JFP).EQ.VERT) THEN                                      G0042620
ISN     152               JBLNEG=(JY-1)*NX+JX                                            G0042630
ISN     153               JBLPOS=JBLNEG+NX                                               G0042640
ISN     154             END IF                                                           G0042650
ISN     155             JGRNEG=JGRPOG(JBLNEG)                                            G0042660
ISN     156             JGRPOS=JGRPOG(JBLPOS)                                            G0042670
ISN     157             COEFFP=FRAC                                                      G0042680
ISN     158             COEFFM=ONE-FRAC                                                  G0042690
C                         IF FRAC IS CLOSE TO ZERO, THEN THE FRONT POINT IS              G0042700
C                         CLOSE TO THE BLOCK POINT ON THE MINUS SIDE, SO COEFFM          G0042710
C                         SHOULD BE CLOSE TO ONE.                                        G0042720
ISN     159             IF (SGP(JGRNEG).LT.SGP(JGRPOS)) THEN                             G0042730
ISN     160               JGRLIQ=JGRNEG                                                  G0042740
ISN     161             ELSE                                                             G0042750
ISN     162               JGRLIQ=JGRPOS                                                  G0042760
ISN     163             END IF                                                           G0042770
ISN     164             JGRF=JAGPOF(2,JFP)                                               G0042780
ISN     165                   P(JGRF) =COEFFM*P(JGRNEG)+COEFFP*P(JGRPOS)                 G0042790
ISN     166                   T(JGRF) =COEFFM*T(JGRNEG)+COEFFP*T(JGRPOS)                 G0042800
ISN     167             XMOLE(1,JGRF)=COEFFM*XMOLE(1,JGRNEG)                             G0042810
                1                   +COEFFP*XMOLE(1,JGRPOS)                              G0042820
ISN     168             XMOLE(2,JGRF)=COEFFM*XMOLE(2,JGRNEG)                             G0042830
                1                   +COEFFP*XMOLE(2,JGRPOS)                              G0042840
ISN     169               SGP(JGRF) = SGP(JGRLIQ)                                        G0042850
ISN     170               SMP(JGRF) = SMP(JGRLIQ)                                        G0042860
ISN     171             WRITE(6,80110)LDUM1,IDUM1,P(JGRF),T(JGRF)                        G0042870
ISN     172             WRITE(9,80110)LDUM1,IDUM1,P(JGRF),T(JGRF)                        G0042880
                                                                                         G0042890
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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
ISN      173                WRITE(6,80111)LDUM2,(XMOLE(I,JGRF),I=1,2),                          G0042900
                1                          SMP(JGRF),SGP(JGRF)                                  G0042910
ISN      174                WRITE(9,80111)LDUM2,(XMOLE(I,JGRF),I=1,2),                          G0042920
                1                          SMP(JGRF),SGP(JGRF)                                  G0042930
ISN      175          311     CONTINUE                                                          G0042940
ISN      176                ENDIF                                                             G0042950
                C                                                                             G0042960
                C           2) EXTRAPOLATE FOR NJAY (IF NDIMNS=1).                            G0042970
ISN      177              IF (NDIMNS.LE.1) THEN                                               G0042980
ISN      178                 NJAYM1=NJAY-1                                                    G0042990
ISN      179                 NJAYM2=NJAY-2                                                    G0043000
                C                COEFFP=(DX(NJAYM2)+DX(NJAYM1))/DX(NJAYM2) HAS DELETED.       G0043010
                C                COEFFM=          -DX(NJAYM1) /DX(NJAYM2) HAS DELETED.        G0043020
ISN      180                    COEFFP= 1.005D0                                               G0043030
ISN      181                    COEFFM=-0.005D0                                               G0043040
ISN      182                        P(NJAY) =COEFFM*  P(NJAYM2)     +COEFFP*  P(NJAYM1)       G0043050
ISN      183                        T(NJAY) =COEFFM*  T(NJAYM2)     +COEFFP*  T(NJAYM1)       G0043060
ISN      184                      SMP(NJAY) =COEFFM*SMP(NJAYM2)     +COEFFP*SMP(NJAYM1)       G0043070
ISN      185                      SGP(NJAY) =COEFFM*SGP(NJAYM2)     +COEFFP*SGP(NJAYM1)       G0043080
ISN      186                    XMOLE(1,NJAY)=COEFFM*XMOLE(1,NJAYM2)+COEFFP*XMOLE(1,NJAYM1)   G0043090
ISN      187                    XMOLE(2,NJAY)=COEFFM*XMOLE(2,NJAYM2)+COEFFP*XMOLE(2,NJAYM1)   G0043100
ISN      188                    WRITE(6,80110)LDUM1,IDUM1,P(NJAY),T(NJAY)                     G0043110
ISN      189                    WRITE(9,80110)LDUM1,IDUM1,P(NJAY),T(NJAY)                     G0043120
ISN      190                    WRITE(6,80111)LDUM2,(XMOLE(I,NJAY),I=1,2),                    G0043130
                1                              SMP(NJAY),SGP(NJAY)                            G0043140
ISN      191                    WRITE(9,80111)LDUM2,(XMOLE(I,NJAY),I=1,2),                    G0043150
                1                              SMP(NJAY),SGP(NJAY)                            G0043160
ISN      192                    END IF                                                        G0043170
ISN      193                 END IF                                                           G0043180
                C                                                                             G0043190
                C           COMPUTE VALUES FOR RELATED VARIABLES.                             G0043200
                C                                                                             G0043210
ISN      194                 DO 321 J=1,NGRPS                                                 G0043220
ISN      195                    SGP(J)=AMAX1(SGP(J),SGIRR)                                    G0043230
ISN      196                    SOP(J)=ONE-SMP(J)-SGP(J)                                      G0043240
ISN      197                    XMOLE(3,J)=ONE-XMOLE(1,J)-XMOLE(2,J)                          G0043250
ISN      198                    R(J)=ZERO                                                     G0043260
ISN      199                    D(J)=ZERO                                                     G0043270
ISN      200                    V(J)=ZERO                                                     G0043280
ISN      201          321 CONTINUE                                                          G0043290
                C                                                                             G0043300
                C           CALCULATE EQUIL AND ADJUST THE TEMPERATURE, WHERE APPROPRIATE.    G0043310
                C           NOTE THAT, IN GENERAL, THIS PROGRAM CANNOT HANDLE                 G0043320
                C           SUPER-HEATED VAPOUR.                                              G0043330
                C                                                                             G0043340
ISN      202                 DO 331 J=1,NGRPS                                                 G0043350
ISN      203                    IF (LBNDOG(J)) THEN                                           G0043360
ISN      204                       JBNDBJ=JBNDOG(J)                                           G0043370
ISN      205                       IF (INJECT(JBNDBJ)) THEN                                   G0043380
ISN      206                          EQUIL(J)=(VAPINJ(JBNDBJ).GT.SGIRR)                      G0043390
ISN      207                       ELSE                                                       G0043400
ISN      208                          EQUIL(J)=(SGP(J).GT.SGIRR)                              G0043410
ISN      209                       END IF                                                     G0043420
ISN      210                    ELSE                                                          G0043430
ISN      211                       EQUIL(J)=(SGP(J).GT.SGIRR)                                 G0043440
ISN      212                    END IF                                                        G0043450
```



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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
                C                                                                             G0043460
ISN      213                 IF (LFRNT(J).AND..NOT.COORTR) EQUIL(J)=.TRUE.                    G0043470
ISN      215                 JARG=J                                                           G0043480
ISN      216                 IF (EQUIL(JARG))                                                 G0043490
                1                CALL VPTEMP(JARG,.FALSE.,.TRUE.,.TRUE.,.FALSE.,             G0043500
                2                            LCTM,NGRPMX,P,XMOLE,                            G0043510
                3                            PEQUIL,T,PHAT,POIL,PSOL,                        G0043520
                4                            DPHAT,DPOIL,DPSOL,IERR,IWRONG)                  G0043530
                C                   I.E. CALL VPTEMP(IPARM,NORMAL,TCHNGE,DERIVS,LHALF,       G0043540
                C                                    LCTM,NGRPMX,P,XMOLE,                     G0043550
                C                                    PEQUIL,T,PHAT,POIL,PSOL,                 G0043560
                C                                    DPHAT,DPOIL,DPSOL,IERR,IWRONG)           G0043570
ISN      218                 IF (IERR.NE.0) STOP                                              G0043580
                C                                                                             G0043590
ISN      220                 IF (LFRNT(J)) WRITE(9,8018)                                      G0043600
ISN      222           8018  FORMAT(' 0'/' OUTPUT FROM TEMPS HAS OMITTED'/' 0')              G0043610
ISN      223           331 CONTINUE                                                          G0043620
                C                                                                             G0043630
ISN      224                 RETURN                                                           G0043640
ISN      225           230 WRITE(6,231)                                                      G0043650
ISN      226           231 FORMAT('1',34('*'),/' *** THE SATS SUBROUTINE FAILED ***',       G0043660
                1            /1X,34('*'))                                                   G0043670
ISN      227                 RETURN                                                           G0043680
ISN      228                 END                                                              G0043690
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STATISTICS SOURCE STATEMENTS = 220, PROGRAM SIZE = 12460 BYTES, PROGRAM NAME = INPUT5 PAGE: 83.

STATISTICS NO DIAGNOSTICS GENERATED.

INPUT5 END OF COMPILATION 15 ******

OPTIONS IN EFFECT: NOLIST NOMAP NOXREF NOGOSTMT NODECK SOURCE TERM NOOBJECT FIXED NOTEST TRMFLG SRCFLG
NOSYM NORENT SDUMP AUTODBL(NONE) NOSXM IL
OPT(0) LANGLVL(77) NOFIPS FLAG(I) NAME(MAIN) LINECOUNT(60) CHARLEN(500)

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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
                C.INPT5B                                                                          G0043700
                C                                                                                 G0043710
                C  S26.  READ THE INPUT FOR THE BOUNDARY CONDITIONS.                              G0043720
                C                                                                                 G0043730
ISN         1         SUBROUTINE INPT5B(JBNDBJ,JKNOWN,J)                                          G0043740
ISN         2         IMPLICIT DOUBLE PRECISION (A-H,K,O-Z)                                       G0043750
                C                                                                                 G0043760
ISN         3         LOGICAL JKNOWN                                                              G0043770
                C                                                                                 G0043780
ISN         4         LOGICAL COORTR,TRACKF,OVTAKE,DATAFR,RESTRT                                  G0043790
ISN         5         LOGICAL OUT,REPEAT,JCTEST,JTINIT,ITERPR,BYWEIT                              G0043800
ISN         6         LOGICAL RCOND,INJECT                                                        G0043810
                C                                                                                 G0043820
ISN         7         COMMON/INJSPC/PGRDNT,TOTINJ,VAPINJ(28),HCBINJ(28),WATINJ(28),               G0043830
                     1                VLCTY,HC1INJ(28),HC2INJ(28),HC3INJ(28),                    G0043840
                     2                V01INJ(28),V02INJ(28),VWAINJ(28)                           G0043850
ISN         8         COMMON/GRIPRO/DT,DXFRNT,DISXM,DX(57),DISTX(58),NFRONT,NBLOKS,               G0043860
                     1             NG,MJAY,COORTR,TRACKF,OVTAKE,DATAFR,RESTRT                    G0043870
ISN         9         COMMON/LOGMIS/OUT,REPEAT,JCTEST,JTINIT,ITERPR,BYWEIT                        G0043880
ISN        10         COMMON/STATEV/SWP(55),SGP(55),SOP(55),T(55),P(55),                          G0043890
                     1             XMOLE(3,55),XO(55),XSOL(55),XW(55)                            G0043900
ISN        11         COMMON/BTBLS1/NBNDBS,JBNDOG(55),JBNDB(50),JBLKOB(28),JINTOB(28)             G0043910
ISN        12         COMMON/SPEC3 /TSPEC(28),PSPEC(28),FSPEC(28)                                 G0043920
ISN        13         COMMON/SPEC4 /RCOND(28),INJECT(28)                                          G0043930
ISN        14         COMMON/BVOLFL/BVFLOW(28),FLFR(150)                                          G0043940
                C                                                                                 G0043950
                CCCCCC (ONE PAGE ONLY)                                                            G0043960
                CCCCCC  INPUT SCALAR : RESTRT                                                     G0043970
                CCCCCC OUTPUT SCALAR : BYWEIT                                                     G0043980
                CCCCCC OUTPUT  ARRAYS: RCOND,INJECT,JINTOB,TSPEC,BSPEC,BVFLOW,                    G0043990
                CCCCCC                 T,FSPEC,PSPEC,P,WATINJ,HCBINJ,VAPINJ,                      G0044000
                CCCCCC                 HC1INJ,HC2INJ,HC3INJ,V01INJ,V02INJ,VWAINJ                  G0044010
                CCCCCC                                                                            G0044020
                CCCCCC                                                                            G0044030
                CCCCCC                 THE BOUNDARY CONDITIONS:                                   G0044040
                CCCCCC                                                                            G0044050
                CCCCCC           RCOND  - T MEANS THAT THE FLOW RATE IS SPECIFIED.                G0044060
                CCCCCC                  - F MEANS THAT THE  PRESSURE IS SPECIFIED.                G0044070
                CCCCCC           INJECT - T MEANS THAT INJECTION RATIOS ARE INCLUDED              G0044080
                CCCCCC                    IN THE DATA.  IT DOES NOT NECESSARILY MEAN             G0044090
                CCCCCC                    THAT THE BLOCK IS AN INJECTION BLOCK AT               G0044100
                CCCCCC                    THE INITIAL TIME.                                     G0044110
                CCCCCC                  - F MEANS THAT THE INJECTION RATIOS ARE                 G0044120
                CCCCCC                    MEANINGLESS BECAUSE THE BLOCK IS NEVER                G0044130
                CCCCCC                    AN INJECTION BLOCK.                                   G0044140
                CCCCCC           JINTOB - SEE THE DESCRIPTION OF THE TABLES.                      G0044150
                CCCCCC           TSPEC  - SPECIFIED TEMPERATURE.                                  G0044160
                CCCCCC           PSPEC  - SPECIFIED PRESSURE.                                     G0044170
                CCCCCC           FSPEC  - SPECIFIED FLOW RATE.                                    G0044180
                CCCCCC           BSPEC  - EITHER PSPEC OR FSPEC DEPENDING ON RCOND.               G0044190
                CCCCCC           BVFLOW - BOUNDARY (TOTAL VOLUMETRIC) FLOW RATE.                  G0044200
                CCCCCC                    POSITIVE BVFLOW MEANS THAT THE FLOW IS INTO            G0044210
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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
                CCCCCC                 THE RESERVOIR.                                             G0044220
                CCCCCC                                                                            G0044230
                CCCCCC           RCOND  EQUIL  BOUNDARY CONDITIONS SPECIFIED                      G0044240
                CCCCCC             T      T     FLOW,TEMPERATURE)                                 G0044250
                CCCCCC             T      F     FLOW,TEMPERATURE                                  G0044260
                CCCCCC             F      T     PRESSURE(,TEMPERATURE)                            G0044270
                CCCCCC             F      F     PRESSURE,TEMPERATURE                              G0044280
                CCCCCC           (1) IF VAPOUR IS PRESENT, IT IS NOT NECESSARY TO                 G0044290
                CCCCCC               PROVIDE THE EXACT BOUNDARY TEMPERATURES: THEY WILL           G0044300
                CCCCCC               BE RECALCULATED.                                             G0044310
                CCCCCC           (2) WHETHER OR NOT VAPOUR IS PRESENT, DON'T BOTHER               G0044320
                CCCCCC               PROVIDING A VALUE FOR BVFLOW.  BVFLOW IS A NUMBER            G0044330
                CCCCCC               WHICH THE COMPUTER STORES AND READS FOR THE                  G0044340
                CCCCCC               PURPOSE OF RESTARTING A SIMULATION.                          G0044350
                C                                                                                 G0044360
ISN        15         READ (5,80112)RCOND(JBNDBJ),INJECT(JBNDBJ),JINTOB(JBNDBJ)                   G0044370
                     1       TSPEC(JBNDBJ),BSPEC,BVFLOW(JBNDBJ)                                  G0044380
ISN        16         WRITE(6,80112)RCOND(JBNDBJ),INJECT(JBNDBJ),JINTOB(JBNDBJ)                   G0044390
                     1       TSPEC(JBNDBJ),BSPEC,BVFLOW(JBNDBJ)                                  G0044400
ISN        17         WRITE(9,80112)RCOND(JBNDBJ),INJECT(JBNDBJ),JINTOB(JBNDBJ)                   G0044410
                     1       TSPEC(JBNDBJ),BSPEC,BVFLOW(JBNDBJ)                                  G0044420
ISN        18  80112  FORMAT(1X,L1,1X,L1,3X,I3,F10.5,2D14.6)                                     G0044430
ISN        19         IF (JKNOWN) T(J)=TSPEC(JBNDBJ)                                              G0044440
ISN        21         IF (RCOND(JBNDBJ)) THEN                                                     G0044450
ISN        22           FSPEC(JBNDBJ)=BSPEC                                                       G0044460
ISN        23           IF (.NOT.RESTRT) BVFLOW(JBNDBJ)=BSPEC                                     G0044470
ISN        25         ELSE                                                                        G0044480
ISN        26           PSPEC(JBNDBJ)=BSPEC                                                       G0044490
ISN        27           IF (JKNOWN.AND..NOT.RESTRT) P(J)=PSPEC(JBNDBJ)                            G0044500
ISN        29         END IF                                                                      G0044510
ISN        30         IF (INJECT(JBNDBJ)) THEN                                                    G0044520
ISN        31           JB=JBNDBJ                                                                 G0044530
                C                                                                                 G0044540
                CCCCCC       BYWEIT - T MEANS THAT WEIGHT FRACTIONS ARE SPECIFIED.                G0044550
                CCCCCC                F MEANS THAT VOLUME FRACTIONS ARE SPECIFIED.               G0044560
                CCCCCC       WATINJ - WATER-PHASE  FRACTION IN THE INJECTED FLUID.                G0044570
                CCCCCC       HCBINJ - HYDROCARBON-PHASE FRACTION IN THE INJECTED FLUID            G0044580
                CCCCCC       VAPINJ - VAPOUR-PHASE FRACTION IN THE INJECTED FLUID.                G0044590
                CCCCCC       HC1INJ - FRACTION OF VOLATILE HYDROCARBON #1                         G0044600
                CCCCCC                IN THE INJECTED HYDROCARBON PHASE.                         G0044610
                CCCCCC       HC2INJ - FRACTION OF VOLATILE HYDROCARBON #2                         G0044620
                CCCCCC                IN THE INJECTED HYDROCARBON PHASE.                         G0044630
                CCCCCC       HC3INJ - FRACTION OF THE NON-VOLATILE HYDROCARBON                    G0044640
                CCCCCC                IN THE INJECTED HYDROCARBON PHASE.                         G0044650
                CCCCCC       V01INJ - FRACTION OF VOLATILE HYDROCARBON #1                         G0044660
                CCCCCC                IN THE INJECTED VAPOUR PHASE.                              G0044670
                CCCCCC       V02INJ - FRACTION OF VOLATILE HYDROCARBON #2                         G0044680
                CCCCCC                IN THE INJECTED VAPOUR PHASE.                              G0044690
                CCCCCC       VWAINJ - FRACTION OF STEAM                                           G0044700
                CCCCCC                IN THE INJECTED VAPOUR PHASE.                              G0044710
                C                                                                                 G0044720
ISN        32         READ (5,80114)BYWEIT,WATINJ(JB),HCBINJ(JB),VAPINJ(JB),                      G0044730
                     1                HC1INJ(JB),HC2INJ(JB),HC3INJ(JB),                          G0044740
ISN        33         WRITE(6,80114)BYWEIT,WATINJ(JB),HCBINJ(JB),VAPINJ(JB),                      G0044750
                     1                HC1INJ(JB),HC2INJ(JB),HC3INJ(JB),                          G0044760
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                 *....*...1.....2.....3.....4.....5.....6.....7.*.....8
                                                                                  VO1INJ(JB),VO2INJ(JB),VMAINJ(JB)                  GO044780
                   2                                                                                                               GO044790
ISN       34                 WRITE(9,80114)BYMEIT,MATINJ(JB),MCBINJ(JB),VAPINJ(JB),                                             GO044800
                   1                                                              MC1INJ(JB),MC2INJ(JB),MC3INJ(JB),                GO044810
                   2                                                              VO1INJ(JB),VO2INJ(JB),VMAINJ(JB)                 GO044820
ISN       35   80114           FORMAT(1X,L1,3(4X,3F7.4))                                                                          GO044830
ISN       36                  END IF                                                                                             GO044840
ISN       37                RETURN                                                                                               GO044850
ISN       38                END
*STATISTICS*   SOURCE STATEMENTS = 35, PROGRAM SIZE = 3828 BYTES, PROGRAM NAME = INPT5B    PAGE:   91.
*STATISTICS*    NO DIAGNOSTICS GENERATED.
**INPT5B** END OF COMPILATION 16 ******
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OPTIONS IN EFFECT:  NOLIST NOMAP NOXREF NOGOSTMT NODECK   SOURCE    TERM NOOBJECT FIXED  NOTEST   TRMFLG   SRCFLG
                    NOSYM NORENT   SDUMP AUTODBL(NONE)   NOSXM     II
                      OPT(0) LANGLVL(77) NOFIPS   FLAG(I)   NAME(MAIN   )  LINECOUNT(60)      CHARLEN(500)

                 *....*...1.....2.....3.....4.....5.....6.....7.*.....8
                 C.TABENT                                                                                                         GO044860
                 C                                                                                                                GO044870
                 C  500.  IDENTIFY THE TABLE SECTIONS TO USE FOR INTERPOLATION.                                                   GO044880
                 C                                                                                                                GO044890
                 C                                                                                                                GO044900
ISN       1           SUBROUTINE TABENT(ISTART,IFINIS,LCTN,NGRPMX,                                                               GO044910
                   1                       NMXTI,NMXXN,NMXSM,NMXSL,MMXT2,                                                       GO044920
                   2                       LTI,NENTTI,TACTEM,TALMUO,TALMUM,TAMMUG,IENTTI,                                       GO044930
                   3                       LXN,NENTXN,TABXN ,TABUOR,                 IENTXN,                                    GO044940
                   4                       LSM,NENTSM,TABSN ,TABKRM,TABKOM,TABPCM,IENTSM,                                       GO044950
                   5                       LSL,NENTSL,TABSL ,TABKRG,TABKOG,TABPCV,IENTSL,                                       GO044960
                   6                       LT2,NENTT2,STMTAB,                        IENTT2,                                    GO044970
                   7                       TTABL,IERR,IMRONG)                                                                   GO044980
ISN       2           IMPLICIT DOUBLE PRECISION (A-H,K,O-Z)                                                                      GO044990
                 C                                                                                                                GO045000
ISN       3           LOGICAL LTI,LXN,LSM,LSL,LT2                                                                                GO045010
ISN       4           DOUBLE PRECISION TACTEM(NMXTI),TALMUO(NMXTI),TALMUM(NMXTI),                                                GO045020
                   1                   TAMMUG(NMXTI)                                                                            GO045030
ISN       5           DOUBLE PRECISION TABXN (NMXXN),TABUOR(NMXXN)                                                               GO045040
ISN       6           DOUBLE PRECISION TABSN (NMXSM),TABKRM(NMXSM),TABKOM(NMXSM),                                                GO045050
                   1                   TABPCM(NMXSM)                                                                            GO045060
ISN       7           DOUBLE PRECISION TABSL (NMXSL),TABKRG(NMXSL),TABKOG(NMXSL),                                                GO045070
                   1                   TABPCV(NMXSL)                                                                            GO045080
ISN       8           DOUBLE PRECISION STMTAB(NMXT2,6)                                                                           GO045090
ISN       9           INTEGER IENTTI(NGRPMX),IENTXN(NGRPMX),IENTSM(NGRPMX),                                                      GO045100
                   1          IENTSL(NGRPMX),IENTT2(NGRPMX)                                                                     GO045110
                 C                                                                                                                GO045120
                 C                                                                                                                GO045130
ISN       10          COMMON/STATEV/SMP(55),SGP(55),SOP(55),T(55),P(55),                                                         GO045140
                   1                  XMOLE(3,55),XO(55),XSOL(55),XN(55)                                                        GO045150
ISN       11          COMMON/BASICS/ZERO,HALF,ONE,TWO                                                                            GO045160
                 C                                                                                                                GO045170
ISN       12          DO 301 I=ISTART,IFINIS                                                                                     GO045180
ISN       13           INON=I                                                                                                    GO045190
                 C  CALCULATE THE IENTRY'S.                                                                                       GO045200
                 C  IN EACH TABLE, IENT IS DEFINED AS FOLLOWS:                                                                    GO045210
                 C  IF IENT IS K, THEN THE INDEPENDENT VARIABLE IS LARGER THAN THE VALUE                                          GO045220
                 C  IN THE K-TH ROW OF THE TABLE, BUT IS SMALLER THAN THE VALUE IN THE                                            GO045230
                 C  (K+1)-TH ROW.                                                                                                 GO045240
                 C                                                                                                                GO045250
                 C  VISCOSITIES AS FUNCTION OF TEMPERATURE.                                                                       GO045260
                 C                                                                                                                GO045270
ISN       14           IF (LTI) THEN                                                                                              GO045280
ISN       15            ITABL=1                                                                                                   GO045290
ISN       16            OLOGTK=OLOG(T(I)+273.1500)                                                                                GO045300
ISN       17   110      CONTINUE                                                                                                  GO045310
ISN       18            IF (OLOGTK.GE.TACTEM(IENTTI(I))) GO TO 115                                                                GO045320
ISN       19            IENTTI(I)=IENTTI(I)-1                                                                                     GO045330
ISN       20            IF (IENTTI(I).LE.0) GO TO 990                                                                             GO045340
ISN       21            GO TO 110                                                                                                 GO045350
ISN       22   115      CONTINUE                                                                                                  GO045360
ISN       23            IF (OLOGTK.LE.TACTEM(IENTTI(I)+1)) GO TO 119                                                              GO045370
ISN       24            IENTTI(I)=IENTTI(I)+1
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                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
ISN       25            IF (IENTTI(I).GE.NENTTI) GO TO 990                                  G0045380
ISN       26            GO TO 115                                                           G0045390
ISN       27      119   CONTINUE                                                            G0045400
ISN       28            END IF                                                              G0045410
                C                                                                         G0045420
                C  RELATIVE VISCOSITY AS FUNCTION OF COMPOSITION.                         G0045430
                C                                                                         G0045440
ISN       29            IF (LXN) THEN                                                       G0045450
ISN       30               ITABL=2                                                          G0045460
ISN       31      120      CONTINUE                                                         G0045470
ISN       32               IF (XMOLE(3,I).GE.TABXN(IENTXN(I))) GO TO 125                    G0045480
ISN       33               IENTXN(I)=IENTXN(I)-1                                            G0045490
ISN       34               IF (IENTXN(I).LE.0) GO TO 990                                    G0045500
ISN       35               GO TO 120                                                        G0045510
ISN       36      125      CONTINUE                                                         G0045520
ISN       37               IF (XMOLE(3,I).LE.TABXN(IENTXN(I)+1)) GO TO 129                  G0045530
ISN       38               IENTXN(I)=IENTXN(I)+1                                            G0045540
ISN       39               IF (IENTXN(I).GE.NENTXN) GO TO 990                               G0045550
ISN       40               GO TO 125                                                        G0045560
ISN       41      129      CONTINUE                                                         G0045570
ISN       42            END IF                                                              G0045580
                C                                                                         G0045590
                C  OIL-WATER KR'S AS FUNCTION OF WATER SATURATION.                        G0045600
                C                                                                         G0045610
ISN       43            IF (LSW) THEN                                                       G0045620
ISN       44               ITABL=3                                                          G0045630
ISN       45               SWPDUM=SWP(I)                                                    G0045640
ISN       46      130      CONTINUE                                                         G0045650
ISN       47               IF (SWPDUM.GE.TABSW(IENTSW(I))) GO TO 135                        G0045660
ISN       48               IENTSW(I)=IENTSW(I)-1                                            G0045670
ISN       49               IF (IENTSW(I).LE.0) GO TO 990                                    G0045680
ISN       50               GO TO 130                                                        G0045690
ISN       51      135      CONTINUE                                                         G0045700
ISN       52               IF (SWPDUM.LE.TABSW(IENTSW(I)+1)) GO TO 139                      G0045710
ISN       53               IENTSW(I)=IENTSW(I)+1                                            G0045720
ISN       54               IF (IENTSW(I).GE.NENTSW) GO TO 990                               G0045730
ISN       55               GO TO 135                                                        G0045740
ISN       56      139      CONTINUE                                                         G0045750
ISN       57            END IF                                                              G0045760
                C                                                                         G0045770
                C  OIL-GAS KR'S AS FUNCTION OF LIQUID SATURATION.                         G0045780
                C                                                                         G0045790
ISN       58            IF (LSL) THEN                                                       G0045800
ISN       59               ITABL=4                                                          G0045810
ISN       60               SLDUM=ONE-SGP(I)                                                 G0045820
ISN       61      140      CONTINUE                                                         G0045830
ISN       62               IF (SLDUM.GE.TABSL(IENTSL(I))) GO TO 145                         G0045840
ISN       63               IENTSL(I)=IENTSL(I)-1                                            G0045850
ISN       64               IF (IENTSL(I).LE.0) GO TO 990                                    G0045860
ISN       65               GO TO 140                                                        G0045870
ISN       66      145      CONTINUE                                                         G0045880
ISN       67               IF (SLDUM.LE.TABSL(IENTSL(I)+1)) GO TO 149                       G0045890
ISN       68               IENTSL(I)=IENTSL(I)+1                                            G0045900
ISN       69               IF (IENTSL(I).GE.NENTSL) GO TO 990                               G0045910
ISN       70               GO TO 145                                                        G0045920
ISN       71      149      CONTINUE                                                         G0045930
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                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
ISN       72            END IF                                                              G0045940
                C                                                                         G0045950
                CC        STEAM PROPERTIES AS A FUNCTION OF TEMPERATURE.                  G0045960
                C                                                                         G0045970
ISN       73         IF (LT2) THEN                                                        G0045980
ISN       74            ITABL=5                                                           G0045990
ISN       75     150    CONTINUE                                                          G0046000
ISN       76            IF (T(I).GE.STMTAB(IENTT2(I),1)) GO TO 155                        G0046010
ISN       77            IENTT2(I)=IENTT2(I)-1                                             G0046020
ISN       78            IF (IENTT2(I).LE.0) GO TO 990                                     G0046030
ISN       79            GO TO 150                                                         G0046040
ISN       80     155    CONTINUE                                                          G0046050
ISN       81            IF (T(I).LE.STMTAB(IENTT2(I)+1,1)) GO TO 159                      G0046060
ISN       82            IENTT2(I)=IENTT2(I)+1                                             G0046070
ISN       83            IF (IENTT2(I).GE.NENTT2) GO TO 990                                G0046080
ISN       84            GO TO 155                                                         G0046090
ISN       85     159    CONTINUE                                                          G0046100
ISN       86         END IF                                                               G0046110
                C                                                                         G0046120
ISN       87      301 CONTINUE                                                            G0046130
ISN       88         ITABL=0                                                              G0046140
ISN       89         RETURN                                                               G0046150
                C                                                                         G0046160
ISN       90      990 CONTINUE                                                            G0046170
ISN       91         IERR=INON                                                            G0046180
ISN       92         IWRONG=INON                                                          G0046190
ISN       93         CALL ERRMSG(7,ITABL,LCTN,ZERO,ZERO)                                  G0046200
                C        I.E. CALL SUBROUTINE ERRMSG(L,I1,I2,R1,R2)                       G0046210
ISN       94         RETURN                                                               G0046220
                C                                                                         G0046230
ISN       95         END                                                                  G0046240
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STATISTICS SOURCE STATEMENTS = 95, PROGRAM SIZE = 5200 BYTES, PROGRAM NAME = TABENT PAGE: 94.

STATISTICS NO DIAGNOSTICS GENERATED.

TABENT END OF COMPILATION 17 ******

OPTIONS IN EFFECT: NOLIST NOMAP NOXREF NOGOSTMT NODECK SOURCE TERM NOOBJECT FIXED NOTEST TRMFLG SRCFLG
NOSYM NORENT SDUMP AUTODBL(NONE) NOSXM IL
OPT(0) LANGLVL(77) NOFIPS FLAG(I) NAME(MAIN) LINECOUNT(60) CHARLEN(500)

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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
                C.TBLGN1                                                                        G0046250
                C                                                                               G0046260
                C  SOO.  GENERATE THE TABLES JBLK, JFPT, JRLG, JGRPOG, JGRPOF, JGRPOR, LFRNT, G0046270
                C                        IOFGRP, JOFGRP, AND JGRPIJ.                            G0046280
                C                                                                               G0046290
ISN         1       SUBROUTINE TBLGN1(OUTP,NVARS,NOMAX,NRMAX,                                   G0046300
                   1                  NBLKMX,NGRPMX,NFPTMX,NRLGMX,                              G0046310
                   2                  NBLKS,NGRPS,NUS,NRLGS,JBLK,JFPT,LFRNT,JRLG,               G0046320
                   3                  JGRPOG,JGRPOF,JAGPOF,JGRPOR,                              G0046330
                   4                  JADJAC,JGRPIJ,IOFGRP,JOFGRP,BLX,BLY,GPX,GPY)              G0046340
ISN         2       IMPLICIT DOUBLE PRECISION (A-H,K,O-Z)                                       G0046350
                C                                                                               G0046360
ISN         3       INTEGER JBLK(NGRPMX),JFPT(NGRPMX),JADJAC(4,NGRPMX)                          G0046370
ISN         4       INTEGER JGRPOG(NBLKMX),JGRPOF(NFPTMX),JAGPOF(9,NFPTMX)                      G0046380
ISN         5       DOUBLE PRECISION BLX(NBLKMX),BLY(NBLKMX),GPX(NGRPMX),GPY(NGRPMX)            G0046390
ISN         6       LOGICAL LFRNT(NGRPMX)                                                       G0046400
ISN         7       LOGICAL OUTP                                                                G0046410
ISN         8       INTEGER JGRPOR(NRLGMX),JRLG(NGRPMX)                                         G0046420
ISN         9       INTEGER JGRPIJ(NOMAX,NRMAX),IOFGRP(NGRPMX),JOFGRP(NGRPMX)                   G0046430
                C                                                                               G0046440
ISN        10       INTEGER FPJX,FPJY                                                           G0046450
ISN        11       LOGICAL L2SYMM,LCIRCL                                                       G0046460
                C                                                                               G0046470
ISN        12       COMMON/BASICS/ZERO,HALF,ONE,TWO                                             G0046480
ISN        13       COMMON/IBASCS/NULL                                                          G0046490
ISN        14       COMMON/DIMENS/NDIMNS,NX,NY,NOS,NRS,NRFM,NRFP                                G0046500
ISN        15       COMMON/FRONT1/NFPTOT,FPJX(16),FPJY(16)                                      G0046510
ISN        16       COMMON/LOGSYM/L2SYMM,LCIRCL                                                 G0046520
                C                                                                               G0046530
                CC  PAGE 1A                                                                     G0046540
                CC   INPUT SCALARS: NRS,NOS,NVARS                                               G0046550
                CC  OUTPUT SCALARS: NGRPS,NUS                                                   G0046560
                CC                                                                              G0046570
                CC  PAGE 1B                                                                     G0046580
                CC   INPUT SCALARS: NULL,L2SYMM,NOMAX,NRFM,NRFP                                 G0046590
                CC  OUTPUT SCALAR : NBLKS                                                       G0046600
                CC  OUTPUT  ARRAYS: JGRPIJ,IOFGRP,JOFGRP,LFRNT,JFPT,JGRPOF,JBLK,JGRPOG         G0046610
                CC                                                                              G0046620
                CC  PAGE 2A                                                                     G0046630
                CC  OUTPUT SCALAR : NRLGS                                                       G0046640
                CC  OUTPUT  ARRAYS: JRLG,JGRPOR,JADJAC                                          G0046650
                CC                                                                              G0046660
                CC  PAGE 2B                                                                     G0046670
                CC   NOTHING NEW                                                                G0046680
                CC                                                                              G0046690
                CC  PAGE --                                                                     G0046700
                CC   INPUT SCALAR : OUTP                                                        G0046710
                CC                                                                              G0046720
                C                                                                               G0046730
ISN        17       NGRPS=1+(NRS-1)*NOS                                                         G0046740
ISN        18       NUS=NVARS*NGRPS                                                             G0046750
                C                                                                               G0046760
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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
                C         STEP 1.  CALCULATE IOFGRP,JOFGRP, AND JGRPIJ                          G0046770
                C                                                                               G0046780
ISN        19       JGRPJ=1                                                                     G0046790
ISN        20       DO  110 I=1,NOS                                                             G0046800
ISN        21         JGRPIJ(I,1)=1                                                             G0046810
ISN        22   110 CONTINUE                                                                   G0046820
ISN        23       IOFGRP(1)=NULL                                                              G0046830
ISN        24       JOFGRP(1)=1                                                                 G0046840
ISN        25       DO 150 J=2,NRS                                                              G0046850
ISN        26         DO 140 I=1,NOS                                                            G0046860
ISN        27           JGRPJ=JGRPJ+1                                                           G0046870
ISN        28           IOFGRP(JGRPJ)=I                                                         G0046880
ISN        29           JOFGRP(JGRPJ)=J                                                         G0046890
ISN        30           JGRPIJ(I,J)=JGRPJ                                                       G0046900
ISN        31   140     CONTINUE                                                                G0046910
ISN        32   150 CONTINUE                                                                   G0046920
                C                                                                               G0046930
                CC      IF (.NOT.L2SYMM) THEN     WAS DELETED.                                  G0046940
                CC        MAKE JGRPIJ CIRCULAR (FOR SRCUPD AND SRCECL).                         G0046950
                CC      IF (NOS.EQ.NOMAX) WRITE(6,154)  WAS DELETED.                            G0046960
                CC  154 FORMAT(' ***+++ NOMAX=NOS -- THEREFORE,'  WAS DELETED.                  G0046970
                CC     1       ' CHANGE THE DIMENSIONS OF JGRPIJ, GLINEQ,',  WAS DELETED.     G0046980
                CC     2       ' AND PERHAPS OTHERS.'/  WAS DELETED.                           G0046990
                CC     3       ' ***+++ OR INCREASE NOMAX BY AT LEAST 1.'/  WAS DELETED.       G0047000
                CC     4       ' ***+++ OR DECREASE  NOS  BY AT LEAST 1.')  WAS DELETED.       G0047010
                CC                                                                              G0047020
                CC      NOSP1=NOS+1  WAS DELETED.                                               G0047030
                CC      DO 160 JR=1,NRS  WAS DELETED.                                           G0047040
                CC         JGRPIJ(NOSP1,JR)=JGRPIJ(1,JR)  WAS DELETED.                          G0047050
                CC           IT WOULD BE COUNTER-PRODUCTIVE TO (RE)DEFINE                       G0047060
                CC           IOFGRP AND JOFGRP HERE.                                            G0047070
                CC  160    CONTINUE  WAS DELETED.                                               G0047080
                CC       END IF  WAS DELETED.                                                   G0047090
                CC                                                                              G0047100
                CC         STEP 2. CALCULATE JBLK, JFPT, JGRPOG, JGRPOF, AND LFRNT.             G0047110
                C                                                                               G0047120
ISN        33       JBLK=0                                                                      G0047130
ISN        34       JFPT=0                                                                      G0047140
ISN        35       DO 210  JGRPJ=1,NGRPS                                                       G0047150
ISN        36         J=JOFGRP(JGRPJ)                                                           G0047160
ISN        37         IF (J.EQ.NRFM.OR.J.EQ.NRFP) THEN                                          G0047170
ISN        38           LFRNT(JGRPJ)=.TRUE.                                                     G0047180
ISN        39           JFPT=JFPT+1                                                             G0047190
ISN        40           JFPT(JGRPJ)=JFPTJ                                                       G0047200
ISN        41           JGRPOF(JFPTJ)=JGRPJ                                                     G0047210
ISN        42           JBLK(JGRPJ)=NULL                                                        G0047220
ISN        43         ELSE                                                                      G0047230
ISN        44           LFRNT(JGRPJ)=.FALSE.                                                    G0047240
ISN        45           JBLK=JBLK+1                                                             G0047250
ISN        46           JBLK(JGRPJ)=JBLKJ                                                       G0047260
ISN        47           JGRPOG(JBLKJ)=JGRPJ                                                     G0047270
ISN        48           JFPT(JGRPJ)=NULL                                                        G0047280
ISN        49         END IF                                                                    G0047290
ISN        50   210 CONTINUE                                                                   G0047300
ISN        51       NBLKS=JBLKJ                                                                G0047310
                C         NFPTOT WAS CALCULATED IN INPUT2.                                      G0047320
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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
                C
                C          STEP 3.  CALCULATE JRLG AND JGRPOR.                                    G0047330
                C                                                                                 G0047340
ISN       52          JRLGJ=0                                                                     G0047350
ISN       53          DO 310 JGRPJ=1,NGRPS                                                        G0047360
ISN       54             I=IOFGRP(JGRPJ)                                                          G0047370
ISN       55             IF (L2SYMM.AND.(I.EQ.1.OR.I.EQ.NOS)) THEN                                G0047380
ISN       56                JRLG(JGRPJ)=NULL                                                      G0047390
ISN       57             ELSE                                                                     G0047400
ISN       58                JRLGJ=JRLGJ+1                                                         G0047410
ISN       59                JRLG(JGRPJ)=JRLGJ                                                     G0047420
ISN       60                JGRPOR(JRLGJ)=JGRPJ                                                   G0047430
ISN       61             END IF                                                                   G0047440
ISN       62    310 CONTINUE                                                                      G0047450
ISN       63          NRLGS=JRLGJ                                                                 G0047460
                C                                                                                 G0047470
                C          STEP 4.  CALCULATE JADJAC.                                             G0047480
                C                                                                                 G0047490
ISN       64          NOSM1=NOS-1                                                                 G0047500
ISN       65          NRSM1=NRS-1                                                                 G0047510
                C                                                                                 G0047520
                C          CALCULATE THE JADJAC IN THE R DIRECTION.                               G0047530
ISN       66          JADJAC(2,1)=NULL                                                            G0047540
ISN       67          JADJAC(4,1)=NULL                                                            G0047550
ISN       68          DO 440 JO=1,NOS                                                             G0047560
ISN       69             DO 430 JR=2,NRS                                                          G0047570
ISN       70                JGRP2=JGRPIJ(JO,JR)                                                   G0047580
ISN       71                IF (JR.GT.2) JGRP1=JGRP2-NOS                                          G0047590
ISN       73                IF (JR.EQ.2) JGRP1=1                                                  G0047600
ISN       75                JADJAC(2,JGRP2)=JGRP1                                                 G0047610
ISN       76                IF (JGRP1.GT.1) JADJAC(4,JGRP1)=JGRP2                                 G0047620
ISN       78                IF (JGRP1.EQ.1) JADJAC(4,JGRP1)=NULL                                  G0047630
ISN       80                IF (JR.EQ.NRS) JADJAC(4,JGRP2)=NULL                                   G0047640
ISN       82    430       CONTINUE                                                                G0047650
ISN       83    440    CONTINUE                                                                   G0047660
                C                                                                                 G0047670
                C          CALCULATE THE JADJAC IN THE THETA DIRECTION.                           G0047680
ISN       84          JADJAC(1,1)=NULL                                                            G0047690
ISN       85          JADJAC(3,1)=NULL                                                            G0047700
ISN       86          DO 460 JR=2,NRS                                                             G0047710
ISN       87             DO 450 JO=2,NOS                                                          G0047720
ISN       88                JGRP2=JGRPIJ(JO,JR)                                                   G0047730
ISN       89                JGRP1=JGRP2-1                                                         G0047740
ISN       90                JADJAC(1,JGRP1)=JGRP2                                                 G0047750
ISN       91                JADJAC(3,JGRP2)=JGRP1                                                 G0047760
ISN       92    450       CONTINUE                                                                G0047770
ISN       93             IF (.NOT.L2SYMM) THEN                                                    G0047780
                C                CONSTRUCT A RING TOPOLOGY.                                       G0047790
ISN       94                JGRP1=JGRPIJ(NOS,JR)                                                  G0047800
ISN       95                JGRP2=JGRPIJ( 1 ,JR)                                                  G0047810
ISN       96                JADJAC(1,JGRP1)=JGRP2                                                 G0047820
ISN       97                JADJAC(3,JGRP2)=JGRP1                                                 G0047830
ISN       98             END IF                                                                   G0047840
ISN       99          IF (L2SYMM) THEN                                                            G0047850
                C                TAKE CARE OF THE "EDGE EFFECTS".                                 G0047860
ISN      100             JADJAC(3,JGRPIJ( 1 ,JR))=NULL                                          G0047870
                                                                                                  G0047880
```



```
                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
ISN      101             JADJAC(1,JGRPIJ(NOS,JR))=NULL                                          G0047890
ISN      102          END IF                                                                     G0047900
ISN      103    460 CONTINUE                                                                     G0047910
                C                                                                                 G0047920
ISN      104       IF (OUTP) THEN                                                               G0047930
                C                                                                                 G0047940
                C          STEP 9.  PRINT OUT MANY OF THE TABLES.                                 G0047950
                C                                                                                 G0047960
ISN      105    901    FORMAT(' -')                                                              G0047970
ISN      106    902    FORMAT(' - JGRP    ',18I4)                                                G0047980
ISN      107    903    FORMAT(' - LFRNT   ',18(3X,L1))                                           G0047990
ISN      108    904    FORMAT(' - JFPT    ',18I4)                                                G0048000
ISN      109    905    FORMAT(' - JBLK    ',18I4)                                                G0048010
ISN      110    906    FORMAT(' - JBLKJ   ',18I4)                                                G0048020
ISN      111    907    FORMAT(' - JGRPOG  ',18I4)                                                G0048030
ISN      112    908    FORMAT(' - JFPTJ   ',18I4)                                                G0048040
ISN      113    909    FORMAT(' - JGRPJ   ',18X,18I4)                                            G0048050
ISN      114    910    FORMAT(' - JGRPOF  ',18I4)                                                G0048060
ISN      115    911    FORMAT(' -JADJAC(',I1,',',I1,',JR)',18I4)                                 G0048070
ISN      116    912    FORMAT(' - JRLGJ   ',18I4)                                                G0048080
ISN      117    913    FORMAT(' - JRLG    ',18I4)                                                G0048090
ISN      118    914    FORMAT(' - JGRPOR  ',18I4)                                                G0048100
                C                                                                                 G0048110
ISN      119          NHORZ=18                                                                    G0048120
ISN      120          WRITE(6,901)                                                                G0048130
ISN      121          DO 932 ISTART=1,NGRPS,NHORZ                                                 G0048140
ISN      122             IFINIS=MIN0(ISTART+NHORZ-1,NGRPS)                                        G0048150
ISN      123             WRITE(6,901)                                                             G0048160
ISN      124             WRITE(6,902)(                  I ,I=ISTART,IFINIS)                       G0048170
ISN      125             WRITE(6,903)(LFRNT(I),I=ISTART,IFINIS)                                   G0048180
ISN      126             WRITE(6,904)( JFPT(I),I=ISTART,IFINIS)                                   G0048190
ISN      127             WRITE(6,905)( JBLK(I),I=ISTART,IFINIS)                                   G0048200
ISN      128             WRITE(6,913)( JRLG(I),I=ISTART,IFINIS)                                   G0048210
ISN      129    932    CONTINUE                                                                   G0048220
                C                                                                                 G0048230
ISN      130          WRITE(6,901)                                                                G0048240
ISN      131          DO 936 ISTART=1,NBLKS,NHORZ                                                 G0048250
ISN      132             IFINIS=MIN0(ISTART+NHORZ-1,NBLKS)                                        G0048260
ISN      133             WRITE(6,901)                                                             G0048270
ISN      134             WRITE(6,906)(                  I ,I=ISTART,IFINIS)                       G0048280
ISN      135             WRITE(6,907)(JGRPOG(I),I=ISTART,IFINIS)                                  G0048290
ISN      136    936    CONTINUE                                                                   G0048300
                C                                                                                 G0048310
ISN      137          IF (NFPTOT.GT.0) THEN                                                       G0048320
ISN      138             WRITE(6,901)                                                             G0048330
ISN      139             DO 938 ISTART=1,NFPTOT,NHORZ                                             G0048340
ISN      140                IFINIS=MIN0(ISTART+NHORZ-1,NFPTOT)                                    G0048350
ISN      141                WRITE(6,901)                                                          G0048360
ISN      142                WRITE(6,908)(                  I ,I=ISTART,IFINIS)                    G0048370
ISN      143                WRITE(6,910)(JGRPOF(I),I=ISTART,IFINIS)                               G0048380
ISN      144    938       CONTINUE                                                                G0048390
ISN      145          END IF                                                                      G0048400
                C                                                                                 G0048410
ISN      146          WRITE(6,901)                                                                G0048420
ISN      147          DO 940 ISTART=1,NRLGS,NHORZ                                                 G0048430
ISN      148             IFINIS=MIN0(ISTART+NHORZ-1,NRLGS)                                        G0048440
```

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                    *....*...1.........2.........3.........4.........5.........6.........7.*.......8

ISN       149                 WRITE(6,901)                                                          G0048450
ISN       150                 WRITE(6,912)(                 I ,I=ISTART,IFINIS)                     G0048460
ISN       151                 WRITE(6,914)(JGRPOR(I),I=ISTART,IFINIS)                               G0048470
ISN       152       940     CONTINUE                                                                G0048480
                    C                                                                               G0048490
ISN       153           END IF                                                                      G0048500
                    C                                                                               G0048510
ISN       154         IF (NDIMNS.GE.2) THEN                                                         G0048520
ISN       155           WRITE(6,901)                                                                G0048530
ISN       156           DO 942 ISTART=1,NGRPS,NHORZ                                                 G0048540
ISN       157             IFINIS=MINO(ISTART+NHORZ-1,NGRPS)                                         G0048550
ISN       158             WRITE(6,901)                                                              G0048560
ISN       159             WRITE(6,909)(         I ,I=ISTART,IFINIS)                                 G0048570
ISN       160             DO 941 ISIDE=1,4                                                          G0048580
ISN       161               WRITE(6,911)ISIDE,(JADJAC(ISIDE,I),I=ISTART,IFINIS)                     G0048590
ISN       162       941     CONTINUE                                                                G0048600
ISN       163       942   CONTINUE                                                                  G0048610
ISN       164           END IF                                                                      G0048620
                    C                                                                               G0048630
ISN       165         RETURN                                                                        G0048640
ISN       166         END                                                                           G0048650

*STATISTICS*   SOURCE STATEMENTS = 161, PROGRAM SIZE = 8116 BYTES, PROGRAM NAME = TBLGN1    PAGE:   97.

*STATISTICS*    NO DIAGNOSTICS GENERATED.

**TBLGN1** END OF COMPILATION 18 ******
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OPTIONS IN EFFECT:  NOLIST NOMAP NOXREF NOGOSTMT NODECK   SOURCE   TERM NOOBJECT FIXED  NOTEST   TRMFLG   SRCFLG
                    NOSYM NORENT   SDUMP AUTODBL(NONE)   NOSXM    IL
                      OPT(0) LANGLVL(77) NOFIPS   FLAG(I)  NAME(MAIN   )  LINECOUNT(60)      CHARLEN(500)

                    *....*...1.........2.........3.........4.........5.........6.........7.*.......8

                    C.BLOKS1                                                                        G0048660
                    C                                                                               G0048670
                    C  S31.  CALCULATE FPDISX/Y, FPDSNM, AND GPX/Y FOR THE FRONT GROUPS.            G0048680
                    C                                                                               G0048690
ISN         1           SUBROUTINE BLOKS1(NFPTMX,NGRPMX,FPDIST,                                     G0048700
                    1                         FPDISX,FPDISY,FPDSNM,GPX,GPY)                         G0048710
ISN         2           IMPLICIT DOUBLE PRECISION (A-H,K,O-Z)                                       G0048720
                    C                                                                               G0048730
ISN         3           INTEGER FPL                                                                 G0048740
ISN         4           DOUBLE PRECISION FPDIST(NFPTMX),FPDISX(NFPTMX),FPDISY(NFPTMX)               G0048750
ISN         5           DOUBLE PRECISION FPDSNM(NFPTMX)                                             G0048760
ISN         6           DOUBLE PRECISION GPX(NGRPMX),GPY(NGRPMX)                                    G0048770
                    C                                                                               G0048780
                    C       THIS IS A DUMMY SUBROUTINE.                                             G0048790
                    C                                                                               G0048800
                    C                                                                               G0048810
ISN         7           RETURN                                                                      G0048820
ISN         8           END                                                                         G0048830

*STATISTICS*   SOURCE STATEMENTS = 8, PROGRAM SIZE = 900 BYTES, PROGRAM NAME = BLOKS1    PAGE:  102.

*STATISTICS*    NO DIAGNOSTICS GENERATED.

**BLOKS1** END OF COMPILATION 19 ******
```

OPTIONS IN EFFECT: NOLIST NOMAP NOXREF NOGOSTMT NODECK SOURCE TERM NOOBJECT FIXED NOTEST TRMFLG SRCFLG
NOSYM NORENT SDUMP AUTODBL(NONE) NOSXM IL
OPT(0) LANGLVL(77) NOFIPS FLAG(I) NAME(MAIN) LINECOUNT(60) CHARLEN(500)

```
                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
                C.CODES                                                                          G0048840
                C                                                                                G0048850
                C  B.01  INITIALIZE CERTAIN CHARACTER STRING CODES.                              G0048860
ISN         1         BLOCK DATA                                                                 G0048870
                C                                                                                G0048880
                C                                                                                G0048890
ISN         2         CHARACTER*4 CYLN,SPHR,CSYSTM                                               G0048900
ISN         3         CHARACTER*6 TRANSP,MATCHC,BOTH,NEITHR,EQTYPE                               G0048910
ISN         4         CHARACTER*4 CENT,FRNI,FRNO,BOUN,AXIS,INTR,EDTYPE                           G0048920
                C                                                                                G0048930
ISN         5         COMMON/CORSYS/CYLN,SPHR,CSYSTM                                             G0048940
ISN         6         COMMON/EQNTYP/TRANSP,MATCHC,BOTH,NEITHR,EQTYPE(10,3)                       G0048950
ISN         7         COMMON/EDGTYP/CENT,FRNI,FRNO,BOUN,AXIS,INTR,EDTYPE(150)                    G0048960
                C                                                                                G0048970
ISN         8         DATA CYLN/'CYLN'/,SPHR/'SPHR'/                                             G0048980
ISN         9         DATA CENT/'CENT'/,FRNI/'FRNI'/,FRNO/'FRNO'/,                               G0048990
                1    BOUN/'BOUN'/,AXIS/'AXIS'/,INTR/'INTR'/                                      G0049000
ISN        10         DATA TRANSP/'TRANSP'/,MATCHC/'MATCHC'/,BOTH/'BOTH  '/,                     G0049010
                1    NEITHR/'NEITHR'/                                                            G0049020
ISN        11         DATA EQTYPE/'TRANSP','TRANSP','TRANSP','TRANSP','TRANSP',                  G0049030
                1              'TRANSP','TRANSP','TRANSP','TRANSP','TRANSP',                     G0049040
                2              'BOTH  ','BOTH  ','BOTH  ','BOTH  ','MATCHC',                     G0049050
                3              'BOTH  ','BOTH  ','BOTH  ','BOTH  ','MATCHC',                     G0049060
                4              'TRANSP','TRANSP','TRANSP','TRANSP','NEITHR',                     G0049070
                5              'TRANSP','TRANSP','TRANSP','TRANSP','NEITHR'/                     G0049080
ISN        12         END                                                                        G0049090
                                                                                                 G0049100
```

STATISTICS SOURCE STATEMENTS = 12, PROGRAM SIZE = 0 BYTES, PROGRAM NAME = BLKDT# PAGE: 103.

STATISTICS NO DIAGNOSTICS GENERATED.

BLKDT# END OF COMPILATION 20 ******

OPTIONS IN EFFECT: NOLIST NOMAP NOXREF NOGOSTMT NODECK SOURCE TERM NOOBJECT FIXED NOTEST TRMFLG SRCFLG
NOSYM NORENT SDUMP AUTODBL(NONE) NOSXM IL
OPT(0) LANGLVL(77) NOFIPS FLAG(I) NAME(MAIN) LINECOUNT(60) CHARLEN(500)

```
                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
                C.DEPGRD                                                                         G0049110
                C                                                                                G0049120
                C  S00.  CALCULATE DRPHHH, AND VARIOUS FUNCTIONS OF THE THETAS.                  G0049130
                C                                                                                G0049140
ISN         1         SUBROUTINE DEPGRD(OUTP,NOMAX,NRMAX,                                        G0049150
                1                   SINTHT,COSTHT,SINTHA,COSTHA,                                 G0049160
                2                   SINIMA,COSIMA,SINIPA,COSIPA,                                 G0049170
                3                   DTHTAM,DTHTAP,DOPHHH,DTHETA,                                 G0049180
                4                   DFQHTM,DFQHTP,DRPHHH,DRADM1,DRADP1)                          G0049190
ISN         2         IMPLICIT DOUBLE PRECISION (A-H,K,O-Z)                                      G0049200
                C                                                                                G0049210
ISN         3         LOGICAL OUTP                                                               G0049220
ISN         4         DOUBLE PRECISION SINTHT(NOMAX),COSTHT(NOMAX)                               G0049230
ISN         5         DOUBLE PRECISION SINTHA(NOMAX),COSTHA(NOMAX)                               G0049240
ISN         6         DOUBLE PRECISION SINIMA(NOMAX),COSIMA(NOMAX)                               G0049250
ISN         7         DOUBLE PRECISION SINIPA(NOMAX),COSIPA(NOMAX)                               G0049260
ISN         8         DOUBLE PRECISION DTHTAM(NOMAX),DTHTAP(NOMAX)                               G0049270
ISN         9         DOUBLE PRECISION DOPHHH(NOMAX),DTHETA(NOMAX)                               G0049280
ISN        10         DOUBLE PRECISION DFQHTM(NOMAX),DFQHTP(NOMAX)                               G0049290
ISN        11         DOUBLE PRECISION DRADM1(NRMAX),DRADP1(NRMAX)                               G0049300
ISN        12         DOUBLE PRECISION DRPHHH(NRMAX)                                             G0049310
                C                                                                                G0049320
ISN        13         LOGICAL L2SYMM,LCIRCL                                                      G0049330
                C                                                                                G0049340
ISN        14         COMMON/BASICS/ZERO,HALF,ONE,TWO                                            G0049350
ISN        15         COMMON/DIMENS/NDIMNS,NX,NY,NOS,NRS,NRFM,NRFP                               G0049360
ISN        16         COMMON/PIES  /HALFPI,PI,TWOPI,PI0180                                       G0049370
ISN        17         COMMON/LOGSYM/L2SYMM,LCIRCL                                                G0049380
ISN        18         COMMON/GLINEC/GLINEO(361),GLINER(24)                                       G0049390
                C                                                                                G0049400
                C  INPUT SCALARS: NRS,HALF,NOS,L2SYMM,THOPI                                      G0049410
                C OUTPUT  ARRAYS: GLINER,GLINEO                                                  G0049420
                C OUTPUT  ARRAYS: SEE ABOVE.                                                     G0049430
                C                                                                                G0049440
                C                                                                                G0049450
                C        CALCULATE DRADM1, DRADP1, AND DRPHHH.                                   G0049460
                C                                                                                G0049470
ISN        19         DO 180 JR=1,NRS                                                            G0049480
ISN        20           RJ=GLINER(JR)                                                            G0049490
ISN        21           IF (JR.EQ.1) RM=RJ                                                       G0049500
ISN        22           IF (JR.GT.1) RM=GLINER(JR-1)                                             G0049510
ISN        23           IF (JR.EQ.NRS) RP=RJ                                                     G0049520
ISN        24           IF (JR.LT.NRS) RP=GLINER(JR+1)                                           G0049530
ISN        25           DRADM1(JR)=RJ-RM                                                         G0049540
ISN        26           DRADP1(JR)=RP-RJ                                                         G0049550
ISN        27           DRPHHH(JR)=HALF*(RP-RM)                                                  G0049560
           28       180 CONTINUE                                                                G0049570
                C                                                                                G0049580
                C        CALCULATE ALL THE ARRAYS WHICH DEPEND ON THE THETAS.                    G0049590
                C                                                                                G0049600
ISN        29         DO 280 JO=1,NOS                                                            G0049610
ISN        30           THETAI=GLINEO(JO)                                                        G0049620
```

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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
ISN        35           SINTHT(JO)=DSIN(THETAI)                                          G0049630
ISN        36           COSTHT(JO)=DCOS(THETAI)                                          G0049640
                C            CALCULATE THETAM.                                          G0049650
ISN        37           IF (JO.EQ.1) THEN                                                G0049660
ISN        38              IF (L2SYMM) THETAM=THETAI                                     G0049670
ISN        40              IF (.NOT.L2SYMM) THETAM=GLINEO(NOS)-THOPI                     G0049680
ISN        42            ELSE                                                           G0049690
ISN        43              THETAM=GLINEO(JO-1)                                          G0049700
ISN        44            END IF                                                         G0049710
                C            CALCULATE THETAP.                                          G0049720
ISN        45           IF (JO.EQ.NOS) THEN                                              G0049730
ISN        46              IF (L2SYMM) THETAP=THETAI                                     G0049740
ISN        48              IF (.NOT.L2SYMM) THETAP=GLINEO(1)+THOPI                       G0049750
ISN        50            ELSE                                                           G0049760
ISN        51              THETAP=GLINEO(JO+1)                                          G0049770
ISN        52            END IF                                                         G0049780
                C            NOW CALCULATE THE ARRAYS THEMSELVES.                       G0049790
ISN        53           THTAIM=HALF*(THETAI+THETAM)                                      G0049800
ISN        54           SINIMA(JO)=DSIN(THTAIM)                                          G0049810
ISN        55           SINTHA(JO)=SINIMA(JO)                                            G0049820
ISN        56           COSIMA(JO)=DCOS(THTAIM)                                          G0049830
ISN        57           COSTHA(JO)=COSIMA(JO)                                            G0049840
                C ->->->->  I SHOULD CHECK THAT SINTHA AND COSTHA ARE CORRECT.          G0049850
ISN        58           THTAIP=HALF*(THETAI+THETAP)                                      G0049860
ISN        59           SINIPA(JO)=DSIN(THTAIP)                                          G0049870
ISN        60           COSIPA(JO)=DCOS(THTAIP)                                          G0049880
                C                                                                       G0049890
ISN        61           DTHTAM(JO)=THETAI-THETAM                                         G0049900
ISN        62           DTHTAP(JO)=THETAP-THETAI                                         G0049910
ISN        63           DOPHHH(JO)=HALF*(THETAP-THETAM)                                  G0049920
ISN        64           DTHETA(JO)=DOPHHH(JO)                                            G0049930
                C ->->->->  THIS LAST STATEMENT IS JUST A GUESS.                        G0049940
                C            THE FORMULAE FOR DFONTM AND DFONTP ARE TRICKIER:           G0049950
ISN        65           DTHETM=THETAI-THETAM                                             G0049960
ISN        66           DTHETP=THETAP-THETAI                                             G0049970
ISN        67           IF (L2SYMM.AND.(JO.EQ.1.OR.JO.EQ.NOS)) THEN                      G0049980
                C               IF L2SYMM IS TRUE, AND JO EQUALS 1 OR NOS,              G0049990
                C               THEN SPECIAL FORMULAE ARE NEEDED:                       G0050000
ISN        68              IF (JO.EQ.1) THEN                                            G0050010
ISN        69                 DFONTM(1)=ZERO                                            G0050020
ISN        70                 DFONTP(1)=ONE/DTHETP                                      G0050030
ISN        71               END IF                                                      G0050040
ISN        72              IF (JO.EQ.NOS) THEN                                          G0050050
ISN        73                 DFONTM(NOS)=ONE/DTHETM                                    G0050060
ISN        74                 DFONTP(NOS)=ZERO                                          G0050070
ISN        75               END IF                                                      G0050080
ISN        76            ELSE                                                          G0050090
ISN        77              DFONTM(JO)=(DTHETP/DTHETM)/(DTHETM+DTHETP)                  G0050100
ISN        78              DFONTP(JO)=(DTHETM/DTHETP)/(DTHETM+DTHETP)                  G0050110
ISN        79            END IF                                                        G0050120
ISN        80     280 CONTINUE                                                         G0050130
                C                                                                       G0050140
ISN        81         IF (OUTP) THEN                                                   G0050150
                C                                                                       G0050160
                C            PRINT OUT THE RESULTS.                                     G0050170
                C                                                                       G0050180
```



```
                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
ISN        82           WRITE(6,331)                                                     G0050190
ISN        83           DO 340 JR=1,NOS                                                  G0050200
ISN        84     331      FORMAT(' -',/,' - JR     GLINER',10X,'DRPHHH')                G0050210
ISN        85     332      FORMAT(' -',I3,2G16.8)                                        G0050220
ISN        86              WRITE(6,332)JR,GLINER(JR),DRPHHH(JR)                          G0050230
ISN        87     340   CONTINUE                                                         G0050240
                C                                                                       G0050250
ISN        88           WRITE(6,351)                                                     G0050260
ISN        89           DO 360 JO=1,NOS                                                  G0050270
ISN        90     351      FORMAT(' -',/,' - JO',' GLINEO  SINTHT  COSTHT ',           G0050280
                1                 ' SINIMA  COSIMA  SINIPA  COSIPA ')                   G0050290
ISN        91     352      FORMAT(' -',I3,7F10.5)                                       G0050300
ISN        92              WRITE(6,352)JO,GLINEO(JO),SINTHT(JO),COSTHT(JO),            G0050310
                1                       SINIMA(JO),COSIMA(JO),SINIPA(JO),COSIPA(JO)   G0050320
ISN        93     360   CONTINUE                                                         G0050330
                C                                                                       G0050340
ISN        94           WRITE(6,371)                                                     G0050350
ISN        95           DO 380 JO=1,NOS                                                  G0050360
ISN        96     371      FORMAT(' -',/,' - JO',' GLINEO  DTHTAM  DTHTAP ',           G0050370
                1                 ' DOPHHH  DTHETA  DFONTM  DFONTP ')                   G0050380
ISN        97     372      FORMAT(' -',I3,7F10.5)                                       G0050390
ISN        98              WRITE(6,372)JO,GLINEO(JO),DTHTAM(JO),DTHTAP(JO),            G0050400
                1                       DOPHHH(JO),DTHETA(JO),DFONTM(JO),DFONTP(JO)   G0050410
ISN        99     380   CONTINUE                                                         G0050420
                C                                                                       G0050430
ISN       100         END IF                                                            G0050440
                C                                                                       G0050450
ISN       101       RETURN                                                            G0050460
ISN       102       END                                                               G0050470
```

STATISTICS SOURCE STATEMENTS = 94, PROGRAM SIZE = 5648 BYTES, PROGRAM NAME = DEPGRD PAGE: 104.

STATISTICS NO DIAGNOSTICS GENERATED.

DEPGRD END OF COMPILATION 21 ******

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OPTIONS IN EFFECT:  NOLIST NOMAP NOXREF NOGOSTMT NODECK   SOURCE   TERM NOOBJECT FIXED  NOTEST   TRMFLG   SRCFLG
                    NOSYM NORENT   SDUMP AUTODBL(NONE)   NOSXM   IL
                      OPT(0) LANGLVL(77) NOFIPS   FLAG(I)   NAME(MAIN  ) LINECOUNT(60)      CHARLEN(500)

                 *....*...1.........2.........3.........4.........5.........6.........7.*.......8
                 C.TBLGN2                                                                          G0050480
                 C                                                                                 G0050490
                 CCCCC  S00.  CALCULATE THE TABLES PERTAINING TO THE SPECIAL CASES                 G0050500
                 C            NEAR THE FRONT AND NEAR THE LINE OF SYMMETRY (IF ANY).               G0050510
ISN         1                SUBROUTINE TBLGN2(OUTP,L2SYMM,NGRPMX,                              G0050520
                            1             JGPTNR,JTYFRN,JTYRFL,JRFLIM)                            G0050530
ISN         2                IMPLICIT DOUBLE PRECISION (A-H,K,O-Z)                              G0050540
                 C                                                                                 G0050550
ISN         3                INTEGER JGPTNR(NGRPMX)                                             G0050560
ISN         4                INTEGER JTYFRN(NGRPMX),JTYRFL(NGRPMX),JRFLIM(NGRPMX)               G0050570
ISN         5                LOGICAL OUTP,L2SYMM                                                G0050580
                 CC                                                                                G0050590
                 C                                                                                 G0050600
ISN         6                COMMON/IBASCS/NULL                                                 G0050610
ISN         7                COMMON/DIMENS/NDIMNS,NX,NY,NOS,NRS,NRFM,NRFP                       G0050620
ISN         8                COMMON/TABLS1/NBLKS,NGRPS,JGRPOG(50),JAGPOF(9,16),                 G0050630
                            1             JBLK(45),JFT(55)                                        G0050640
ISN         9                COMMON/IJTBIJ/IOFGRP(55),JOFGRP(55),JGRPIJ(36,24)                  G0050650
                 CCCCCC                                                                            G0050660
                 CCCCCC INPUT SCALARS: NGRPS,NRFM,NRFP,NOS,NULL,L2SYMM                             G0050670
                 CCCCCC  INPUT  ARRAYS: IOFGRP,JOFGRP,JGRPIJ                                       G0050680
                 CCCCCC OUTPUT  ARRAYS: JGPTNR,JTYFRN,JTYRFL,JRFLIM                                G0050690
                 CCCCCC                                                                            G0050700
                 CCCCCC       JGPTNR - THE "OTHER" OR "PARTNER" GROUP IN AN                        G0050710
                 CCCCCC                INNER-FRONT-GROUP / OUTER-FRONT-GROUP  PAIR.               G0050720
                 CCCCCC                                                                            G0050730
                 CCCCCC       JTYFRN = 2  IF THE GROUP IS AT THE FRONT ON THE INNER SIDE.          G0050740
                 CCCCCC              = 3  IF THE GROUP IS AT THE FRONT ON THE OUTER SIDE.          G0050750
                 CCCCCC              = 1  OTHERWISE.                                              G0050760
                 CCCCCC                                                                            G0050770
                 CCCCCC       JTYRFL = 4  IF THE GROUP IS A FICTITIOUS GROUP,                      G0050780
                 CCCCCC                   I.E. IT IS GENERATED BY REFLECTION                       G0050790
                 CCCCCC                   IN THE LINE OF SYMMETRY (IF ONE EXISTS).                 G0050800
                 CCCCCC              = 3  IF THE GROUP IS                                          G0050810
                 CCCCCC                   ON THE LINE OF SYMMETRY (IF ONE EXISTS).                 G0050820
                 CCCCCC              = 2  IF THE GROUP IS A REAL GROUP                             G0050830
                 CCCCCC                   ADJACENT TO A GROUP LOCATED                              G0050840
                 CCCCCC                   ON THE LINE OF SYMMETRY (IF ONE EXISTS).                 G0050850
                 CCCCCC              = 1  OTHERWISE (OR IF THERE IS NO LINE OF SYMMETRY).          G0050860
                 CCCCCC                                                                            G0050870
                 CCCCCC       JRFLIM - THE IMAGE GROUP UNDER REFLECTION                            G0050880
                 CCCCCC                IN THE LINE OF SYMMETRY (IF ONE EXISTS).                   G0050890
                 CCCCCC                                                                            G0050900
                 CCCCCC                JTYRFL(JGRPJ)    JRFLIM(JGRPJ)    JTYRFL(JRFLIM(JGRPJ))  G0050910
                 CCCCCC                      1                NULL                               G0050920
                 CCCCCC                      2             DEFINED                 4             G0050930
                 CCCCCC                      3                NULL                               G0050940
                 CCCCCC                      4             DEFINED                 2             G0050950
                 CCCCCC                                                                            G0050960
                 CCCCCC                                                                            G0050970
                 CCCCCC                                                                            G0050980
                 CCCCCC                                                                            G0050990
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                 *....*...1.........2.........3.........4.........5.........6.........7.*.......8
                 C          STEP 1.  CALCULATE JGPTNR AND JTYFRN.                                  G0051000
                 C                                                                                 G0051010
ISN        10                JGPTNR(1)=NULL                                                     G0051020
ISN        11                JTYFRN(1)=1                                                        G0051030
ISN        12                DO 180 JGRPJ=1,NGRPS                                               G0051040
ISN        13                   I=IOFGRP(JGRPJ)                                                 G0051050
ISN        14                   J=JOFGRP(JGRPJ)                                                 G0051060
ISN        15                   IF (J.EQ.NRFM.OR.J.EQ.NRFP) THEN                                G0051070
ISN        16                      IF (J.EQ.NRFM) THEN                                          G0051080
ISN        17                         JGPTNR(JGRPJ)=JGRPIJ(I,NRFP)                              G0051090
ISN        18                         JTYFRN(JGRPJ)=2                                           G0051100
ISN        19                      END IF                                                       G0051110
ISN        20                      IF (J.EQ.NRFP) THEN                                          G0051120
ISN        21                         JGPTNR(JGRPJ)=JGRPIJ(I,NRFM)                              G0051130
ISN        22                         JTYFRN(JGRPJ)=3                                           G0051140
ISN        23                      END IF                                                       G0051150
ISN        24                   ELSE                                                            G0051160
ISN        25                      JGPTNR(JGRPJ)=NULL                                           G0051170
ISN        26                      JTYFRN(JGRPJ)=1                                              G0051180
ISN        27                   END IF                                                          G0051190
ISN        28           180 CONTINUE                                                            G0051200
                 CCCCC                                                                             G0051210
                 CCCCC      STEP 2.  CALCULATE JTYRFL AND JRFLIM.                                  G0051220
ISN        29                NOSM1=NOS-1                                                        G0051230
ISN        30                NOSM2=NOS-2                                                        G0051240
ISN        31                JTYRFL(1)=1                                                        G0051250
ISN        32                JRFLIM(1)=NULL                                                     G0051260
ISN        33                DO 280 JGRPJ=2,NGRPS                                               G0051270
ISN        34                   I=IOFGRP(JGRPJ)                                                 G0051280
ISN        35                   J=JOFGRP(JGRPJ)                                                 G0051290
ISN        36                   IF ((.NOT.L2SYMM).OR.(I.GT.3.AND.I.LT.NOSM2)) THEN              G0051300
ISN        37                      JTYRFL(JGRPJ)=1                                              G0051310
ISN        38                      JRFLIM(JGRPJ)=NULL                                           G0051320
ISN        39                   END IF                                                          G0051330
ISN        40                   IF (L2SYMM) THEN                                                G0051340
ISN        41                      IF (I.EQ.3.OR.I.EQ.NOSM2) THEN                               G0051350
ISN        42                         JTYRFL(JGRPJ)=2                                           G0051360
ISN        43                         IF (I.EQ.3    ) JRFLIM(JGRPJ)=JGRPIJ( 1 ,J)              G0051370
ISN        45                         IF (I.EQ.NOSM2) JRFLIM(JGRPJ)=JGRPIJ(NOS,J)               G0051380
ISN        47                      END IF                                                       G0051390
ISN        48                      IF (I.EQ.2.OR.I.EQ.NOSM1) THEN                               G0051400
ISN        49                         JTYRFL(JGRPJ)=3                                           G0051410
ISN        50                         JRFLIM(JGRPJ)=NULL                                        G0051420
ISN        51                      END IF                                                       G0051430
ISN        52                      IF (I.EQ.1.OR.I.EQ.NOS) THEN                                 G0051440
ISN        53                         JTYRFL(JGRPJ)=4                                           G0051450
ISN        54                         IF (I.EQ.1  ) JRFLIM(JGRPJ)=JGRPIJ( 3 ,J)                 G0051460
ISN        56                         IF (I.EQ.NOS) JRFLIM(JGRPJ)=JGRPIJ(NOSM2,J)               G0051470
ISN        58                      END IF                                                       G0051480
ISN        59                   END IF                                                          G0051490
ISN        60           280 CONTINUE                                                            G0051500
                 C                                                                                 G0051510
ISN        61                IF (OUTP) THEN                                                     G0051520
                 C                                                                                 G0051530
                 C          STEP 3.  PRINT OUT THE TABLES.                                         G0051540
                 C                                                                                 G0051550
```

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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
                C                                                                              G0051560
                  301    FORMAT(' - ')                                                         G0051570
ISN       62      302    FORMAT(' - JGRPJ   ',1814)                                            G0051580
ISN       63      303    FORMAT(' - JTYFRN  ',1814)                                            G0051590
ISN       64      304    FORMAT(' - JTYRFL  ',1814)                                            G0051600
ISN       65      305    FORMAT(' - JRFLIN  ',1814)                                            G0051610
ISN       66      306    FORMAT(' - JGPTNR  ',1814)                                            G0051620
                C                                                                              G0051630
ISN       67            NHORZ=18                                                             G0051640
ISN       68            WRITE(6,301)                                                         G0051650
ISN       69            DO 312 ISTART=1,NGRPS,NHORZ                                          G0051660
ISN       70               IFINIS=MINO(ISTART+NHORZ-1,NGRPS)                                 G0051670
ISN       71               WRITE(6,301)                                                      G0051680
ISN       72               WRITE(6,302)(     I ,I=ISTART,IFINIS)                             G0051690
ISN       73            WRITE(6,306)(JGPTNR(I),I=ISTART,IFINIS)                              G0051700
ISN       74               WRITE(6,303)(JTYFRN(I),I=ISTART,IFINIS)                           G0051710
ISN       75               WRITE(6,304)(JTYRFL(I),I=ISTART,IFINIS)                           G0051720
ISN       76               WRITE(6,305)(JRFLIN(I),I=ISTART,IFINIS)                           G0051730
ISN       77     312    CONTINUE                                                             G0051740
                C                                                                              G0051750
ISN       78           END IF                                                                G0051760
                C                                                                              G0051770
ISN       79         RETURN                                                                  G0051780
ISN       80         END                                                                     G0051790
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STATISTICS SOURCE STATEMENTS = 77, PROGRAM SIZE = 4112 BYTES, PROGRAM NAME = TBLGN2 PAGE: 107.

STATISTICS NO DIAGNOSTICS GENERATED.

TBLGN2 END OF COMPILATION 22 ******

OPTIONS IN EFFECT: NOLIST NOMAP NOXREF NOGOSTMT NODECK SOURCE TERM NOOBJECT FIXED NOTEST TRMFLG SRCFLG
NOSYM NORENT SDUMP AUTODBL(NONE) NOSXM IL
OPT(0) LANGLVL(77) NOFIPS FLAG(I) NAME(MAIN) LINECOUNT(60) CHARLEN(500)

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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
                C.TBLGN3                                                                       G0051800
                C                                                                              G0051810
                C  S00.  CALCULATE THE TABLES PERTAINING TO THE BAND STRUCTURE                 G0051820
                C        OF THE MATRIX.                                                        G0051830
                C                                                                              G0051840
ISN        1       SUBROUTINE TBLGN3(OUTP,MCONMX,MGRPMX,MBANMX,                               G0051850
                1                        MCONXS,JBDIAG,JOFSMN,JOFSMX,                          G0051860
                2                        JWORK1,JWORK2,LWORK3,                                 G0051870
                3                        JCONX,JGRPOC,JNEIBR,OUTLIE,J1CONX,MNEIBS)             G0051880
ISN        2       IMPLICIT DOUBLE PRECISION (A-H,K,O-Z)                                      G0051890
                C                                                                              G0051900
ISN        3       LOGICAL OUTP                                                               G0051910
ISN        4       LOGICAL OUTLIE(MCONMX),LWORK3(MCONMX)                                      G0051920
ISN        5       INTEGER JGRPOC(MCONMX),JNEIBR(MCONMX)                                      G0051930
ISN        6       INTEGER JWORK1(MCONMX),JWORK2(MCONMX)                                      G0051940
ISN        7       INTEGER J1CONX(MGRPMX),MNEIBS(MGRPMX),JCONX(MBANMX,MGRPMX)                 G0051950
ISN        8       INTEGER JGADJV(4)                                                          G0051960
                C                                                                              G0051970
ISN        9       INTEGER FPJX,FPJY                                                          G0051980
ISN       10       LOGICAL LFRNT                                                              G0051990
ISN       11       LOGICAL L2SYMN,LCIRCL                                                      G0052000
                C                                                                              G0052010
ISN       12       COMMON/IBASCS/NULL                                                         G0052020
ISN       13       COMMON/DIMENS/NDIMMS,NX,NY,NOS,NRS,NRFM,NRFP                               G0052030
ISN       14       COMMON/FRONT1/NFPTOT,FPJX(16),FPJY(16)                                     G0052040
ISN       15       COMMON/TABLS1/NBLKS,NGRPS,JGRPOG(50),JAGPOF(9,16),                         G0052050
                1                  JBLK(45),JFPT(55)                                       G0052060
ISN       16       COMMON/TABL1A/LFRNT(55)                                                    G0052070
ISN       17       COMMON/ADJACN/IFORWL,JUPGRP(16),JADJAC(4,55)                               G0052080
ISN       18       COMMON/LOGSYM/L2SYMN,LCIRCL                                                G0052090
ISN       19       COMMON/LJTBIJ/IOFGRP(55),JOFGRP(55),JGRPIJ(36,24)                          G0052100
ISN       20       COMMON/TABLS2/NBLGS,JGRPOF(16),JRLG(54),JGRPOR(54),                        G0052110
                1                  JGPTNR(55),JTYFRN(55),JTYRFL(55),JRFLIN(55)             G0052120
                C                                                                              G0052130
                C  INPUT SCALARS: MCONMX,MGRPMX,MBANMX,NX,NY,NFPTOT,NULL,NGRPS,L2SYMN         G0052140
                C  INPUT  ARRAYS: IOFGRP,JOFGRP,JTYRFL,JRFLIN,JTYFRN,JADJAC,LFRNT             G0052150
                C  LOCAL  ARRAY : JGADJV                                                       G0052160
                C  OUTPUT SCALAR: MCONXS                                                       G0052170
                C  OUTPUT ARRAYS: JCONX,JGRPOC,JNEIBR,J1CONX,MNEIBS                            G0052180
                C                                                                              G0052190
                C                                                                              G0052200
                C     STEP 1.  MAKE A LIST OF ALL CONNECTIONS.                                 G0052210
                C              DO NOT ATTEMPT, YET, TO SORT THEM.                              G0052220
                C                                                                              G0052230
                C     THE CENTRE GROUP (GROUP #1) IS A SPECIAL CASE.                           G0052240
ISN       21       JCONXJ=1                                                                   G0052250
ISN       22       JGRPOC(JCONXJ)=1                                                           G0052260
ISN       23       JNEIBR(JCONXJ)=1                                                           G0052270
ISN       24       OUTLIE(JCONXJ)=.FALSE.                                                     G0052280
                C     NOW FOR THE OTHER GROUPS.                                              G0052290
ISN       25       DO 180 JGRPJ=2,NGRPS                                                       G0052300
ISN       26          I=IOFGRP(JGRPJ)                                                         G0052310
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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
ISN       27            J=JOFGRP(JGRPJ)                                                        G0052320
ISN       28            IF (JTYRFL(JGRPJ).NE.4) THEN                                           G0052330
ISN       29               JGADJV(1)=JADJAC(3,JGRPJ)                                           G0052340
ISN       30               JGADJV(2)=JGRPJ                                                     G0052350
ISN       31               JGADJV(3)=JADJAC(1,JGRPJ)                                           G0052360
                C                 SINCE JTYRFL(JGRPJ) IS NOT 4, THESE THREE JGADJV'S          G0052370
                C                 ARE NEVER NULL.                                             G0052380
ISN       32               NI=3                                                                G0052390
                C                                                                             G0052400
                C                 THE FOLLOWING SECTION APPEARS TO BE SUPERFLUOUS:            G0052410
                C            IF (L2SYMM.AND.(JTYRFL(JGRPJ).EQ.2)) THEN                        G0052420
                C               JGADJV(4)=JRFLIM(JGRPJ)                                       G0052430
                C               NI=4                                                          G0052440
                C             END IF                                                          G0052450
ISN       33            DO 160 IV=1,NI                                                         G0052460
ISN       34               JGRP2=JGADJV(IV)                                                    G0052470
ISN       35               IF (JTYRFL(JGRP2).NE.4) THEN                                        G0052480
ISN       36                  JGRP3=JADJAC(2,JGRP2)                                            G0052490
ISN       37                  IF (LFRNT(JGRP3)) THEN                                           G0052500
ISN       38                     JGRP4=JADJAC(2,JGRP3)                                         G0052510
ISN       39                     IF (JGRP4.GT.1.OR.IV.EQ.2) THEN                               G0052520
                C                       IN ORDER TO AVOID COUNTING THE CONNECTION             G0052530
                C                       WITH GROUP #1 MORE THAN ONCE.                         G0052540
ISN       40                        JCONXJ=JCONXJ+1                                           G0052550
ISN       41                        JGRPOC(JCONXJ)=JGRPJ                                      G0052560
ISN       42                        JNEIBR(JCONXJ)=JGRP4                                      G0052570
ISN       43                        OUTLIE(JCONXJ)=.FALSE.                                    G0052580
ISN       44                        IF (JGRP4.EQ.1) THEN                                      G0052590
                C                          IF THIS IF STATEMENT IS EXECUTED,                  G0052600
                C                          THEN  IV.EQ.2  IS AUTOMATICALLY TRUE.              G0052610
ISN       45                           JCONXJ=JCONXJ+1                                        G0052620
ISN       46                           JGRPOC(JCONXJ)=1                                       G0052630
ISN       47                           JNEIBR(JCONXJ)=JGRPJ                                   G0052640
ISN       48                           OUTLIE(JCONXJ)=.FALSE.                                 G0052650
ISN       49                        END IF                                                    G0052660
ISN       50                     END IF                                                       G0052670
ISN       51                  END IF                                                          G0052680
                C                                                                             G0052690
ISN       52                  IF (JGRP3.GT.1.OR.IV.EQ.2) THEN                               G0052700
                C                    IN ORDER TO AVOID COUNTING THE CONNECTION             G0052710
                C                    WITH GROUP #1 MORE THAN ONCE.                         G0052720
ISN       53                     JCONXJ=JCONXJ+1                                            G0052730
ISN       54                     JGRPOC(JCONXJ)=JGRPJ                                       G0052740
ISN       55                     JNEIBR(JCONXJ)=JGRP3                                       G0052750
ISN       56                     OUTLIE(JCONXJ)=.FALSE.                                     G0052760
ISN       57                     IF (JGRP3.EQ.1) THEN                                       G0052770
                C                       IF THIS IF STATEMENT IS EXECUTED,                  G0052780
                C                       THEN  IV.EQ.2  IS AUTOMATICALLY TRUE.              G0052790
ISN       58                        JCONXJ=JCONXJ+1                                         G0052800
ISN       59                        JGRPOC(JCONXJ)=1                                        G0052810
ISN       60                        JNEIBR(JCONXJ)=JGRPJ                                    G0052820
ISN       61                        OUTLIE(JCONXJ)=.FALSE.                                  G0052830
ISN       62                     END IF                                                     G0052840
ISN       63                  END IF                                                        G0052850
                C                                                                         G0052860
                C                                                                         G0052870
```



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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
ISN       64                     JCONXJ=JCONXJ+1                                            G0052880
ISN       65                     JGRPOC(JCONXJ)=JGRPJ                                       G0052890
ISN       66                     JNEIBR(JCONXJ)=JGRP2                                       G0052900
ISN       67                     OUTLIE(JCONXJ)=.FALSE.                                     G0052910
                C                                                                         G0052920
ISN       68                     JGRP5=JADJAC(4,JGRP2)                                      G0052930
ISN       69                     IF (JGRP5.GT.NULL) THEN                                    G0052940
ISN       70                        JCONXJ=JCONXJ+1                                         G0052950
ISN       71                        JGRPOC(JCONXJ)=JGRPJ                                    G0052960
ISN       72                        JNEIBR(JCONXJ)=JGRP5                                    G0052970
ISN       73                        OUTLIE(JCONXJ)=.FALSE.                                  G0052980
ISN       74                        IF (LFRNT(JGRP5)) THEN                                  G0052990
ISN       75                           JGRP6=JADJAC(4,JGRP5)                                G0053000
ISN       76                           IF (JGRP6.GT.NULL) THEN                              G0053010
ISN       77                              JCONXJ=JCONXJ+1                                   G0053020
ISN       78                              JGRPOC(JCONXJ)=JGRPJ                              G0053030
ISN       79                              JNEIBR(JCONXJ)=JGRP6                              G0053040
ISN       80                              OUTLIE(JCONXJ)=.FALSE.                            G0053050
ISN       81                           END IF                                               G0053060
ISN       82                        END IF                                                  G0053070
ISN       83                     END IF                                                     G0053080
                C                                                                         G0053090
ISN       84                  END IF                                                       G0053100
ISN       85      160      CONTINUE                                                        G0053110
ISN       86               END IF                                                         G0053120
ISN       87      180 CONTINUE                                                            G0053130
                C                                                                         G0053140
                C        STEP 2.  ADD TO THE LIST THE OUTLIER CONNECTIONS.                G0053150
                C                                                                         G0053160
ISN       88            DO 250 JO=1,NOS                                                 G0053170
ISN       89               JGRPJ=JGRPIJ(JO,NRFP)                                        G0053180
ISN       90               IF (NRFP.GT.3) THEN                                          G0053190
ISN       91                  JCONXJ=JCONXJ+1                                           G0053200
ISN       92                  JGRPOC(JCONXJ)=JGRPJ                                      G0053210
ISN       93                  JNEIBR(JCONXJ)=1                                          G0053220
ISN       94                  OUTLIE(JCONXJ)=.TRUE.                                     G0053230
ISN       95               END IF                                                       G0053240
ISN       96               DO 240 JR=2,NRS                                              G0053250
ISN       97                  IF (JR.LT.(NRFP-2).OR.JR.GT.(NRFP+1)) THEN                G0053260
ISN       98                     JGRP7=JGRPIJ(JO,JR)                                    G0053270
ISN       99                     JCONXJ=JCONXJ+1                                        G0053280
ISN      100                     JGRPOC(JCONXJ)=JGRPJ                                   G0053290
ISN      101                     JNEIBR(JCONXJ)=JGRP7                                   G0053300
ISN      102                     OUTLIE(JCONXJ)=.TRUE.                                  G0053310
ISN      103                     JGRP8=JADJAC(1,JGRP7)                                  G0053320
ISN      104                     IF (JGRP8.GT.NULL) THEN                                G0053330
ISN      105                        JCONXJ=JCONXJ+1                                     G0053340
ISN      106                        JGRPOC(JCONXJ)=JGRPJ                                G0053350
ISN      107                        JNEIBR(JCONXJ)=JGRP8                                G0053360
ISN      108                        OUTLIE(JCONXJ)=.TRUE.                               G0053370
ISN      109                     END IF                                                 G0053380
ISN      110                     JGRP9=JADJAC(3,JGRP7)                                  G0053390
ISN      111                     IF (JGRP9.GT.NULL) THEN                                G0053400
ISN      112                        JCONXJ=JCONXJ+1                                     G0053410
ISN      113                        JGRPOC(JCONXJ)=JGRPJ                                G0053420
ISN      114                        JNEIBR(JCONXJ)=JGRP9                                G0053430
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                 *....*...1.....2.....3.....4.....5.....6.....7.*.....8
C
ISN      115                    OUTLIE(JCONXJ)=.TRUE.                                  G0053440
ISN      116                  END IF                                                   G0053450
ISN      117                END IF                                                     G0053460
ISN      118     240    CONTINUE                                                       G0053470
ISN      119     250 CONTINUE                                                         G0053480
                C                                                                    G0053490
ISN      120         NCONXS=JCONXJ                                                   G0053500
                C                                                                    G0053510
                C       STEP 3. SORT THE ARRAYS JGRPOC AND JNEIBR                    G0053520
                C               USING MY TRICKY FOUR-LOOP RADIX SORT (TWICE).        G0053530
                C                                                                    G0053540
ISN      121         DO 310 JCONXJ=1,NCONXS                                          G0053550
ISN      122           JWORK1(JCONXJ)=JNEIBR(JCONXJ)                                 G0053560
ISN      123           JWORK2(JCONXJ)=JGRPOC(JCONXJ)                                 G0053570
ISN      124           LWORK3(JCONXJ)=OUTLIE(JCONXJ)                                 G0053580
ISN      125     310 CONTINUE                                                        G0053590
                C                                                                    G0053600
ISN      126         DO 315 JGRPJ=1,NGRPS                                            G0053610
ISN      127           NNEIBS(JGRPJ)=0                                               G0053620
ISN      128     315 CONTINUE                                                        G0053630
                C                                                                    G0053640
ISN      129         DO 320 JCONXJ=1,NCONXS                                          G0053650
ISN      130           JGRPJ=JWORK1(JCONXJ)                                          G0053660
ISN      131           NNEIBS(JGRPJ)=NNEIBS(JGRPJ)+1                                 G0053670
ISN      132     320 CONTINUE                                                        G0053680
                C                                                                    G0053690
ISN      133         J1CONX(1)=1                                                     G0053700
ISN      134         DO 325 JGRPJ=2,NGRPS                                            G0053710
ISN      135           J1CONX(JGRPJ)=J1CONX(JGRPJ-1)+NNEIBS(JGRPJ-1)                 G0053720
ISN      136     325 CONTINUE                                                        G0053730
                C                                                                    G0053740
ISN      137         DO 330 JCONXD=1,NCONXS                                          G0053750
                C           JCONXD - DONOR                                           G0053760
                C           JCONXR - RECIPIENT                                       G0053770
ISN      138           JGRPJ=JWORK1(JCONXD)                                          G0053780
ISN      139           JCONXR=J1CONX(JGRPJ)                                          G0053790
ISN      140           JNEIBR(JCONXR)=JWORK1(JCONXD)                                 G0053800
ISN      141           JGRPOC(JCONXR)=JWORK2(JCONXD)                                 G0053810
ISN      142           OUTLIE(JCONXR)=LWORK3(JCONXD)                                 G0053820
ISN      143           J1CONX(JGRPJ)=J1CONX(JGRPJ)+1                                 G0053830
ISN      144     330 CONTINUE                                                        G0053840
                C                                                                    G0053850
ISN      145         DO 360 JCONXJ=1,NCONXS                                          G0053860
ISN      146           JWORK1(JCONXJ)=JGRPOC(JCONXJ)                                 G0053870
ISN      147           JWORK2(JCONXJ)=JNEIBR(JCONXJ)                                 G0053880
ISN      148           LWORK3(JCONXJ)=OUTLIE(JCONXJ)                                 G0053890
ISN      149     360 CONTINUE                                                        G0053900
                C                                                                    G0053910
ISN      150         DO 365 JGRPJ=1,NGRPS                                            G0053920
ISN      151           NNEIBS(JGRPJ)=0                                               G0053930
ISN      152     365 CONTINUE                                                        G0053940
                C                                                                    G0053950
ISN      153         DO 370 JCONXJ=1,NCONXS                                          G0053960
ISN      154           JGRPJ=JWORK1(JCONXJ)                                          G0053970
ISN      155           NNEIBS(JGRPJ)=NNEIBS(JGRPJ)+1                                 G0053980
ISN      156     370 CONTINUE                                                        G0053990
```



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                 *....*...1.....2.....3.....4.....5.....6.....7.*.....8
C                                                                                    G0054000
ISN      157         J1CONX(1)=1                                                     G0054010
ISN      158         DO 375 JGRPJ=2,NGRPS                                            G0054020
ISN      159           J1CONX(JGRPJ)=J1CONX(JGRPJ-1)+NNEIBS(JGRPJ-1)                 G0054030
ISN      160     375 CONTINUE                                                        G0054040
                C                                                                    G0054050
ISN      161         DO 380 JCONXD=1,NCONXS                                          G0054060
                C           JCONXD - DONOR                                           G0054070
                C           JCONXR - RECIPIENT                                       G0054080
ISN      162           JGRPJ=JWORK1(JCONXD)                                          G0054090
ISN      163           JCONXR=J1CONX(JGRPJ)                                          G0054100
ISN      164           JGRPOC(JCONXR)=JWORK1(JCONXD)                                 G0054110
ISN      165           JNEIBR(JCONXR)=JWORK2(JCONXD)                                 G0054120
ISN      166           OUTLIE(JCONXR)=LWORK3(JCONXD)                                 G0054130
ISN      167           J1CONX(JGRPJ)=J1CONX(JGRPJ)+1                                 G0054140
ISN      168     380 CONTINUE                                                        G0054150
                C                                                                    G0054160
ISN      169         NGRPP2=NGRPS+2                                                  G0054170
ISN      170         DO 390 JG=2,NGRPS                                               G0054180
ISN      171           JGRPJ=NGRPP2-JG                                               G0054190
ISN      172           J1CONX(JGRPJ)=J1CONX(JGRPJ-1)                                 G0054200
ISN      173     390 CONTINUE                                                        G0054210
ISN      174         J1CONX(1)=1                                                     G0054220
                C                                                                    G0054230
                C       STEP 4. CALCULATE JCONX.                                     G0054240
                C                                                                    G0054250
                C       FIRST CALCULATE BANDWIDTHS.                                  G0054260
ISN      175         JOFSMN=0                                                        G0054270
ISN      176         JOFSMX=0                                                        G0054280
                C                                                                    G0054290
ISN      177         DO 410 JCONXJ=1,NCONXS                                          G0054300
ISN      178           IF (.NOT.OUTLIE(JCONXJ)) THEN                                 G0054310
ISN      179             JOFFST=JNEIBR(JCONXJ)-JGRPOC(JCONXJ)                        G0054320
ISN      180             JOFSMN=MINO(JOFSMN,JOFFST)                                  G0054330
ISN      181             JOFSMX=MAXO(JOFSMX,JOFFST)                                  G0054340
ISN      182           END IF                                                        G0054350
ISN      183     410 CONTINUE                                                        G0054360
ISN      184         NBANDM=JOFSMX-JOFSMN+1                                          G0054370
ISN      185     412 FORMAT(' OFS - THE OFFSETS VARY BETWEEN ',I3,' AND ',I2)        G0054380
ISN      186     414 FORMAT(' ***+++TBLGN3; FATAL ERROR: NBANDM (=',I3,') IS LARGER',G0054390
                1                          ' THAN NBANMX (=',I3,').')                G0054400
ISN      187         WRITE(6,412)JOFSMN,JOFSMX                                       G0054410
ISN      188         IF (NBANDM.GT.NBANMX) WRITE(6,414)NBANDM,NBANMX                 G0054420
ISN      190         IF (NBANDM.GT.NBANMX) WRITE(9,414)NBANDM,NBANMX                 G0054430
                C       NEXT, SET JCONX TO NULL.                                     G0054440
ISN      192         DO 430 JGRPJ=1,NGRPS                                            G0054450
ISN      193           DO 420 JBANDJ=1,NBANDM                                        G0054460
ISN      194             JCONX(JBANDJ,JGRPJ)=NULL                                    G0054470
ISN      195     420     CONTINUE                                                    G0054480
ISN      196     430 CONTINUE                                                        G0054490
                C       NOW FILL IN JCONX.                                           G0054500
ISN      197         DO 440 JCONXJ=1,NCONXS                                          G0054510
ISN      198           IF (.NOT.OUTLIE(JCONXJ)) THEN                                 G0054520
ISN      199             JGRPJ =JGRPOC(JCONXJ)                                       G0054530
ISN      200             JBANDJ=JNEIBR(JCONXJ)-JGRPOC(JCONXJ)-JOFSMN+1               G0054540
ISN      201             JCONX(JBANDJ,JGRPJ)=JCONXJ                                  G0054550
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                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
ISN      202                END IF                                                  G0054560
ISN      203          450 CONTINUE                                                  G0054570
                C           ALSO, CALCULATE JBDIAG.                                G0054580
ISN      204            JBDIAG=1-JOFSMN                                            G0054590
                C                                                                  G0054600
                C           STEP 5. PRINT OUT THE TABLES, IF DESIRED.              G0054610
                C                                                                  G0054620
ISN      205            IF (OUTP) THEN                                             G0054630
ISN      206              501   FORMAT(' -')                                       G0054640
ISN      207              502   FORMAT(' - JCONXJ  ',18I4)                         G0054650
ISN      208              503   FORMAT(' - JGRPOC  ',18I4)                         G0054660
ISN      209              504   FORMAT(' - JNEIBR  ',18I4)                         G0054670
ISN      210              505   FORMAT(' - JGRPJ   ',18I4)                         G0054680
ISN      211              506   FORMAT(' - J1CONX  ',18I4)                         G0054690
ISN      212              507   FORMAT(' - NNEIBS  ',18I4)                         G0054700
ISN      213              508   FORMAT(' - OUTLIE  ',18(3X,L1))                    G0054710
ISN      214              509   FORMAT(' -JCONX(',I2,',',18I4)                     G0054720
                C                                                                  G0054730
ISN      215                    NHORZ=18                                           G0054740
                C                                                                  G0054750
ISN      216                    WRITE(6,501)                                       G0054760
ISN      217                    DO 512 IA=1,NCONXS,NHORZ                           G0054770
ISN      218                       IZ=MINO(IA+NHORZ-1,NCONXS)                      G0054780
ISN      219                       WRITE(6,501)                                    G0054790
ISN      220                       WRITE(6,502)(          I ,I=IA,IZ)              G0054800
ISN      221                       WRITE(6,503)(JGRPOC(I),I=IA,IZ)                 G0054810
ISN      222                       WRITE(6,504)(JNEIBR(I),I=IA,IZ)                 G0054820
ISN      223                       WRITE(6,508)(OUTLIE(I),I=IA,IZ)                 G0054830
ISN      224              512   CONTINUE                                           G0054840
                C                                                                  G0054850
ISN      225                    WRITE(6,501)                                       G0054860
ISN      226                    DO 514 IA=1,NGRPS,NHORZ                            G0054870
ISN      227                       IZ=MINO(IA+NHORZ-1,NGRPS)                       G0054880
ISN      228                       WRITE(6,501)                                    G0054890
ISN      229                       WRITE(6,505)(          I ,I=IA,IZ)              G0054900
ISN      230                       WRITE(6,506)(J1CONX(I),I=IA,IZ)                 G0054910
ISN      231                       WRITE(6,507)(NNEIBS(I),I=IA,IZ)                 G0054920
ISN      232              514   CONTINUE                                           G0054930
                C                                                                  G0054940
ISN      233                    WRITE(6,501)                                       G0054950
ISN      234                    DO 530 IA=1,NGRPS,NHORZ                            G0054960
ISN      235                       IZ=MINO(IA+NHORZ-1,NGRPS)                       G0054970
ISN      236                       WRITE(6,501)                                    G0054980
ISN      237                       WRITE(6,505)(          I ,I=IA,IZ)              G0054990
ISN      238                       DO 520 JBANDJ=1,NBANDM                          G0055000
ISN      239                          WRITE(6,509)JBANDJ,(JCONX(JBANDJ,I),I=IA,IZ) G0055010
ISN      240              520      CONTINUE                                        G0055020
ISN      241              530   CONTINUE                                           G0055030
                C                                                                  G0055040
ISN      242                 END IF                                                G0055050
                C                                                                  G0055060
ISN      243              RETURN                                                    G0055070
ISN      244              END                                                       G0055080
*STATISTICS*   SOURCE STATEMENTS = 242, PROGRAM SIZE = 10268 BYTES, PROGRAM NAME = TBLGN3    PAGE: 110.
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*STATISTICS*    NO DIAGNOSTICS GENERATED.
**TBLGN3** END OF COMPILATION 23 ******
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OPTIONS IN EFFECT: NOLIST NOMAP NOXREF NOGOSTMT NODECK SOURCE TERM NOOBJECT FIXED NOTEST TRMFLG SRCFLG
NOSYM NOREENT SDUMP AUTODBL(NONE) NOSXM IL
OPT(0) LANGLVL(77) NOFIPS FLAG(I) NAME(MAIN) LINECOUNT(60) CHARLEN(500)

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                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
                C.EDGGN1                                                                GO055090
                C                                                                       GO055100
                C  S00.  CALCULATE THE FIRST SET OF EDGE TABLES.                        GO055110
                C                                                                       GO055120
ISN         1       SUBROUTINE EDGGN1(OUTP,NDIRS,NGRPMX,NFPTMX,NDIRMX,NEDGMX,       GO055130
                1                 NEDGES,JEDGOF,EDPTNR,FREDGE,LNULED,LBNDED,    GO055140
                2                 JBLKOE,JGRPOE,JDIROE,JEDGOG,EDGOR ,EDPARM,    GO055150
                3                 JPFPME,JPFPPO,JPFPVE,JPFPHO,JPEDVE,JPEDHO)    GO055160
ISN         2       IMPLICIT DOUBLE PRECISION (A-H,K,O-Z)                           GO055170
                C                                                                       GO055180
ISN         3       CHARACTER*4 DIREXN,EDGOR(NEDGMX),EDPARM(NEDGMX)                 GO055190
ISN         4       LOGICAL OUTP,LEXPR,FREDGE(NEDGMX),LNULED(NEDGMX),LBNDED(NEDGMX) GO055200
ISN         5       INTEGER JBLKOE(4,NEDGMX),JGRPOE(6,NEDGMX),JDIROE(2,NEDGMX)      GO055210
ISN         6       INTEGER EDPTNR(NEDGMX)                                          GO055220
ISN         7       INTEGER JEDGOF(2,NFPTMX)                                        GO055230
ISN         8       INTEGER JEDGOG(NDIRMX,NGRPMX)                                   GO055240
ISN         9       INTEGER JPFPME(NFPTMX),JPFPPO(NFPTMX)                           GO055250
ISN        10       INTEGER JPFPVE(NFPTMX),JPFPHO(NFPTMX)                           GO055260
ISN        11       INTEGER JPEDVE(NFPTMX),JPEDHO(NFPTMX)                           GO055270
ISN        12       INTEGER JADJAM(4,55)                                            GO055280
                                                                                        GO055290
                C                                                                       GO055300
ISN        13       CHARACTER*4 HORZ,VERT                                           GO055310
ISN        14       INTEGER FPJX,FPJY                                               GO055320
ISN        15       CHARACTER*4 FPHY                                                GO055330
ISN        16       LOGICAL LFRNT                                                   GO055340
ISN        17       LOGICAL L2SYMM,LCIRCL                                           GO055350
ISN        18       CHARACTER*4 CENT,FRNT,FRNO,BOUN,AXIS,INTR,EDTYPE                GO055360
                C                                                                       GO055370
ISN        19       COMMON/BASICS/ZERO,HALF,ONE,TWO                                 GO055380
ISN        20       COMMON/IBASCS/NULL                                              GO055390
ISN        21       COMMON/DIMENS/NDIMNS,NX,NY,NOS,NRS,NRFM,NRFP                    GO055400
ISN        22       COMMON/DIRXNC/HORZ,VERT                                         GO055410
ISN        23       COMMON/FRONT1/NFPTOT,FPJX(16),FPJY(16)                          GO055420
ISN        24       COMMON/FRONT2/FPHY(16)                                          GO055430
ISN        25       COMMON/TABLS1/NBLKS,NGRPS,JGRPOG(50),JAGPOF(9,16),              GO055440
                1                 JBLK(55),JFPT(55)                             GO055450
ISN        26       COMMON/TABL1A/LFRNT(55)                                         GO055460
ISN        27       COMMON/ADJACN/IFORML,JUPGRP(16),JADJAC(4,55)                    GO055470
ISN        28       COMMON/LOGSYM/L2SYMM,LCIRCL                                     GO055480
ISN        29       COMMON/EDGTYP/CENT,FRNT,FRNO,BOUN,AXIS,INTR,EDTYPE(150)         GO055490
ISN        30       COMMON/TABLS2/NRLGS,JGRPOF(16),JRLG(55),JGRPOR(54),             GO055500
                1                 JGPTNR(55),JTYFRN(55),JTYRFL(55),JRFLIM(55)   GO055510
                C                                                                       GO055520
                C  PAGE 1A                                                              GO055530
                C   INPUT SCALARS: NOS,VERT,CENTR,NRFM,HORZ                            GO055540
                C  OUTPUT  ARRAYS: EDGOR,EDPARM,FREDGE,JGRPOE,JEDGOG                    GO055550
                C                                                                       GO055560
                C  PAGE 2A                                                              GO055570
                C   INPUT SCALARS: L2SYMM,INTR,AXIS,NULL                               GO055580
                C                                                                       GO055590
                C  PAGE 2B                                                              GO055600
                C   NOTHING NEW
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                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
                C                                                                       GO055610
                C  PAGE 3A                                                              GO055620
                C   INPUT SCALARS: FRNT,NRFP,FRNO                                      GO055630
                C   INPUT  ARRAY : JFPT                                                GO055640
                C  OUTPUT  ARRAY : JEDGOF                                               GO055650
                C                                                                       GO055660
                C  PAGE 4A                                                              GO055670
                C   INPUT SCALARS: NRS,BOUN                                            GO055680
                C  OUTPUT SCALAR : NEDGES                                               GO055690
                C                                                                       GO055700
                C  PAGE ---                                                             GO055710
                C   INPUT SCALAR : OUTP                                                GO055720
                C                                                                       GO055730
                C                                                                       GO055740
                C                                                                       GO055750
                C         THE EDGES ADJOINING THE CENTRE GRID BLOCK.                    GO055760
                C                                                                       GO055770
ISN        31       JGRPO=1                                                         GO055780
ISN        32       JEDGEJ=0                                                        GO055790
ISN        33       DO 140 JO=1,NOS                                                 GO055800
ISN        34          JEDGEJ=JEDGEJ+1                                              GO055810
ISN        35          EDGOR (JEDGEJ)=VERT                                          GO055820
ISN        36          FREDGE(JEDGEJ)=.FALSE.                                       GO055830
ISN        37          EDPARM(JEDGEJ)=CENT                                          GO055840
ISN        38          JGRPS=JGRPO+JO                                               GO055850
ISN        39          JGRPOE(2,JEDGEJ)=1                                           GO055860
ISN        40          JGRPOE(5,JEDGEJ)=JGRPS                                       GO055870
                C        JEDGOG(2,JGRPS) =JEDGEJ  HAS DELETED.                      GO055880
ISN        41       140 CONTINUE                                                    GO055890
ISN        42       JEDGOG(1,1)=NULL                                                GO055900
ISN        43       JEDGOG(2,1)=NULL                                                GO055910
ISN        44       JEDGOG(3,1)=NULL                                                GO055920
ISN        45       JEDGOG(4,1)=NULL                                                GO055930
                C                                                                       GO055940
                C         THE INTERIOR EDGES INSIDE THE FRONT.                      GO055950
                C                                                                       GO055960
                C         THE VERTICAL EDGES ADJOINING THE CENTRE EDGES.            GO055970
ISN        46       JGRPO=1                                                         GO055980
ISN        47       DO 210 JO=1,NOS                                                 GO055990
ISN        48          JEDGEJ=JEDGEJ+1                                              GO056000
ISN        49          EDGOR(JEDGEJ)=VERT                                           GO056010
ISN        50          FREDGE(JEDGEJ)=.FALSE.                                       GO056020
ISN        51          EDPARM(JEDGEJ)=INTR                                          GO056030
ISN        52          JGRPS=JGRPO+JO                                               GO056040
ISN        53          JGRPOE(2,JEDGEJ)=1                                           GO056050
ISN        54          JGRPOE(5,JEDGEJ)=JGRPS                                       GO056060
                C           THE OTHER JGRPOE ARE CALCULATED LATER.                  GO056070
ISN        55          JEDGOG(2,JGRPS)=JEDGEJ                                       GO056080
ISN        56       210 CONTINUE                                                    GO056090
                C                                                                       GO056100
ISN        57       DO 290 JR=2,NRFM                                                GO056110
ISN        58          JGRPO=1+(JR-2)*NOS                                           GO056120
                C              HORIZONTAL EDGES.                                        GO056130
ISN        59          DO 260 JO=1,NOS                                              GO056140
ISN        60             JEDGEJ=JEDGEJ+1                                           GO056150
ISN        61             EDGOR(JEDGEJ)=HORZ                                        GO056160
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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
ISN       62              FREDGE(JEDGEJ)=.FALSE.                                          G0056170
ISN       63              IF (.NOT.L2SYMM) THEN                                           G0056180
ISN       64                 EDPARM(JEDGEJ)=INTR                                          G0056190
ISN       65                 JGRP2=JGRPO+JO                                               G0056200
ISN       66                 IF (JO.LT.NOS) JGRP5=JGRP2+1                                 G0056210
ISN       68                 IF (JO.EQ.NOS) JGRP5=JGRPO+1                                 G0056220
ISN       70               END IF                                                         G0056230
ISN       71              IF (L2SYMM) THEN                                                G0056240
ISN       72                 JGRP5=JGRPO+JO                                               G0056250
ISN       73                 IF (JO.EQ.1) THEN                                            G0056260
ISN       74                    EDPARM(JEDGEJ)=AXIS                                       G0056270
ISN       75                    JGRP2=NULL                                                G0056280
ISN       76                 ELSE                                                         G0056290
ISN       77                    EDPARM(JEDGEJ)=INTR                                       G0056300
ISN       78                    JGRP2=JGRP5-1                                             G0056310
ISN       79                 END IF                                                       G0056320
ISN       80               END IF                                                         G0056330
ISN       81              JGRPOE(2,JEDGEJ)=JGRP2                                          G0056340
ISN       82              IF (JGRP2.GT.NULL) JEDGOG(1,JGRP2)=JEDGEJ                       G0056350
ISN       84              JGRPOE(5,JEDGEJ)=JGRP5                                          G0056360
ISN       85              IF (JGRP5.GT.NULL) JEDGOG(3,JGRP5)=JEDGEJ                       G0056370
ISN       87    260     CONTINUE                                                          G0056380
                C                IF L2SYMM IS  TRUE, THEN THERE ARE NOS+1 EDGES.        G0056390
                C                IF L2SYMM IS FALSE, THEN THERE ARE ONLY NOS EDGES.     G0056400
                C                THEREFORE:                                             G0056410
ISN       88              IF (L2SYMM) THEN                                                G0056420
ISN       89                 JEDGEJ=JEDGEJ+1                                              G0056430
ISN       90                 EDGOR (JEDGEJ)=HORZ                                          G0056440
ISN       91                 FREDGE(JEDGEJ)=.FALSE.                                       G0056450
ISN       92                 EDPARM(JEDGEJ)=AXIS                                          G0056460
ISN       93                 JGRP2=JGRPO+NOS                                              G0056470
ISN       94                 JGRPOE(5,JEDGEJ)=NULL                                        G0056480
ISN       95                 JGRPOE(2,JEDGEJ)=JGRP2                                       G0056490
ISN       96                 JEDGOG(1,JGRP2 )=JEDGEJ                                      G0056500
ISN       97               END IF                                                         G0056510
                C                NOW FOR THE OTHER VERTICAL EDGES.                      G0056520
ISN       98              DO 280 JO=1,NOS                                                 G0056530
ISN       99                 JEDGEJ=JEDGEJ+1                                              G0056540
ISN      100                 EDGOR (JEDGEJ)=VERT                                          G0056550
ISN      101                 FREDGE(JEDGEJ)=.FALSE.                                       G0056560
ISN      102                 EDPARM(JEDGEJ)=INTR                                          G0056570
ISN      103                 IF (JR.EQ.NRFM) THEN                                         G0056580
ISN      104                    JGRP2=JGRPO+JO-NOS                                        G0056590
ISN      105                    JGRP5=JGRP2+NOS                                           G0056600
ISN      106                    JEDGOG(4,JGRP5)=JEDGEJ                                    G0056610
ISN      107                 ELSE                                                         G0056620
ISN      108                    JGRP2=JGRPO+JO                                            G0056630
ISN      109                    JGRP5=JGRP2+NOS                                           G0056640
ISN      110                    JEDGOG(4,JGRP2)=JEDGEJ                                    G0056650
ISN      111                    JEDGOG(2,JGRP5)=JEDGEJ                                    G0056660
ISN      112                 END IF                                                       G0056670
ISN      113                 JGRPOE(2,JEDGEJ)=JGRP2                                       G0056680
ISN      114                 JGRPOE(5,JEDGEJ)=JGRP5                                       G0056690
ISN      115    280     CONTINUE                                                          G0056700
ISN      116    290 CONTINUE                                                             G0056710
                C                                                                       G0056720
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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
                C        INNER FRONT EDGES.                                             G0056730
                C                                                                       G0056740
                C                        JTYFRM(JGRPOE(2,JEDGEJ))  JTYFRM(JGRPOE(5,JEDGEJ))  G0056750
                C        INCORRECT               2                         3            G0056760
                C          CORRECT               1                         2            G0056770
                C                                                                       G0056780
                C        YES, THIS MEANS THAT THREE ROWS OF EDGES HAVE THE SAME JGRPOE. G0056790
ISN      117              JGRPO=1+(NRFM-2)*NOS                                           G0056800
ISN      118              DO 340 JO=1,NOS                                                G0056810
ISN      119                 JEDGEJ=JEDGEJ+1                                             G0056820
ISN      120                 EDGOR (JEDGEJ)=VERT                                         G0056830
ISN      121                 FREDGE(JEDGEJ)=.TRUE.                                       G0056840
ISN      122                 EDPARM(JEDGEJ)=FRNI                                         G0056850
ISN      123                 JGRP2=JGRPO+JO-NOS                                          G0056860
ISN      124                 JGRP5=JGRP2+NOS                                             G0056870
ISN      125                 JGRPOE(2,JEDGEJ)=JGRP2                                      G0056880
ISN      126                 JGRPOE(5,JEDGEJ)=JGRP5                                      G0056890
ISN      127                 JGRP5A=JGRP5                                                G0056900
ISN      128                 JGRP5B=JGRP5A+NOS                                           G0056910
ISN      129                 JEDGOF(1,JFPT(JGRP5A))=JEDGEJ                               G0056920
ISN      130                 JEDGOF(1,JFPT(JGRP5B))=JEDGEJ                               G0056930
ISN      131    340 CONTINUE                                                             G0056940
                C                                                                       G0056950
                C        OUTER FRONT EDGES.                                             G0056960
                C                                                                       G0056970
                C                        JTYFRM(JGRPOE(2,JEDGEJ))  JTYFRM(JGRPOE(5,JEDGEJ))  G0056980
                C        INCORRECT               2                         3            G0056990
                C          CORRECT               3                         1            G0057000
                C                                                                       G0057010
                C        YES, THIS MEANS THAT THREE ROWS OF EDGES HAVE THE SAME JGRPOE. G0057020
                C                                                                       G0057030
ISN      132              JGRPO=1+(NRFP-2)*NOS                                           G0057040
ISN      133              DO 360 JO=1,NOS                                                G0057050
ISN      134                 JEDGEJ=JEDGEJ+1                                             G0057060
ISN      135                 EDGOR (JEDGEJ)=VERT                                         G0057070
ISN      136                 FREDGE(JEDGEJ)=.TRUE.                                       G0057080
ISN      137                 EDPARM(JEDGEJ)=FRNO                                         G0057090
ISN      138                 JGRP5=JGRPO+JO+NOS                                          G0057100
ISN      139                 JGRP2=JGRP5-NOS                                             G0057110
ISN      140                 JGRPOE(2,JEDGEJ)=JGRP2                                      G0057120
ISN      141                 JGRPOE(5,JEDGEJ)=JGRP5                                      G0057130
ISN      142                 JGRP2B=JGRP2                                                G0057140
ISN      143                 JGRP2A=JGRP2B-NOS                                           G0057150
ISN      144                 JEDGOF(2,JFPT(JGRP2B))=JEDGEJ                               G0057160
ISN      145                 JEDGOF(2,JFPT(JGRP2A))=JEDGEJ                               G0057170
ISN      146    360 CONTINUE                                                             G0057180
                C                                                                       G0057190
                C        THE INTERIOR EDGES OUTSIDE THE FRONT.                          G0057200
                C                                                                       G0057210
ISN      147              DO 490 JR=NRFP,NRS                                             G0057220
ISN      148                 JGRPO=1+(JR-2)*NOS                                          G0057230
                C                   THIS TIME DO THE VERTICAL EDGES FIRST.              G0057240
ISN      149                 DO 460 JO=1,NOS                                             G0057250
ISN      150                    JEDGEJ=JEDGEJ+1                                          G0057260
ISN      151                    EDGOR (JEDGEJ)=VERT                                      G0057270
                                                                                        G0057280
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                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
ISN       152               FREDGE(JEDGEJ)=.FALSE.                                 G0057290
ISN       153               EDPARM(JEDGEJ)=INTR                                    G0057300
ISN       154               IF (JR.EQ.NRFP) THEN                                   G0057310
ISN       155                  JGRP4=JGRPO+JO+NOS                                  G0057320
ISN       156                  JGRP2=JGRP4-NOS                                     G0057330
ISN       157                  JEDGOG(2,JGRP2)=JEDGEJ                              G0057340
ISN       158                ELSE                                                  G0057350
ISN       159                  JGRP5=JGRPO+JO                                      G0057360
ISN       160                  JGRP2=JGRP5-NOS                                     G0057370
ISN       161                  JEDGOG(4,JGRP2)=JEDGEJ                              G0057380
ISN       162                  JEDGOG(2,JGRP5)=JEDGEJ                              G0057390
ISN       163                END IF                                                G0057400
ISN       164               JGRPOE(2,JEDGEJ)=JGRP2                                 G0057410
ISN       165               JGRPOE(5,JEDGEJ)=JGRP5                                 G0057420
ISN       166     460     CONTINUE                                                 G0057430
                C               NOW FOR THE HORIZONTAL EDGES.                      G0057440
ISN       167               DO 480 JO=1,NOS                                        G0057450
ISN       168                  JEDGEJ=JEDGEJ+1                                     G0057460
ISN       169                  EDGOR(JEDGEJ)=HORZ                                  G0057470
ISN       170                  FREDGE(JEDGEJ)=.FALSE.                              G0057480
ISN       171                  IF (.NOT.L2SYMM) THEN                               G0057490
ISN       172                     EDPARM(JEDGEJ)=INTR                              G0057500
ISN       173                     JGRP2=JGRPO+JO                                   G0057510
ISN       174                     IF (JO.LT.NOS) JGRP5=JGRP2+1                     G0057520
ISN       176                     IF (JO.EQ.NOS) JGRP5=JGRPO+1                     G0057530
ISN       178                   END IF                                             G0057540
ISN       179                  IF (L2SYMM) THEN                                    G0057550
ISN       180                     JGRP5=JGRPO+JO                                   G0057560
ISN       181                     IF (JO.EQ.1) THEN                                G0057570
ISN       182                        EDPARM(JEDGEJ)=AXIS                           G0057580
ISN       183                        JGRP2=NULL                                    G0057590
ISN       184                      ELSE                                            G0057600
ISN       185                        EDPARM(JEDGEJ)=INTR                           G0057610
ISN       186                        JGRP2=JGRP5-1                                 G0057620
ISN       187                      END IF                                          G0057630
ISN       188                   END IF                                             G0057640
ISN       189                  JGRPOE(2,JEDGEJ)=JGRP2                              G0057650
ISN       190                  IF (JGRP2.GT.NULL)  JEDGOG(1,JGRP2)=JEDGEJ          G0057660
ISN       192                  JGRPOE(5,JEDGEJ)=JGRP5                              G0057670
ISN       193                  IF (JGRP5.GT.NULL) JEDGOG(3,JGRP5)=JEDGEJ           G0057680
ISN       195     480     CONTINUE                                                 G0057690
                C                  IF  L2SYMM IS  TRUE, THEN THERE ARE NOS+1 EDGES. G0057700
                CCC                IF L2SYMM IS FALSE, THEN THERE ARE ONLY NOS EDGES. G0057710
                C                  THEREFORE:                                      G0057720
ISN       196               IF (L2SYMM) THEN                                       G0057730
ISN       197                  JEDGEJ=JEDGEJ+1                                     G0057740
ISN       198                  EDGOR (JEDGEJ)=HORZ                                 G0057750
ISN       199                  FREDGE(JEDGEJ)=.FALSE.                              G0057760
ISN       200                  EDPARM(JEDGEJ)=AXIS                                 G0057770
ISN       201                  JGRP2=JGRPO+NOS                                     G0057780
ISN       202                  JGRPOE(4,JEDGEJ)=NULL                               G0057790
ISN       203                  JGRPOE(2,JEDGEJ)=JGRP2                              G0057800
ISN       204                  JEDGOG(1,JGRP2 )=JEDGEJ                             G0057810
ISN       205                END IF                                                G0057820
ISN       206     490 CONTINUE                                                     G0057830
                C                                                                  G0057840
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                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
                C          THE OUTSIDE BOUNDARY EDGES.                             G0057850
                C                                                                  G0057860
ISN       207           JGRPO=1+(NRS-2)*NOS                                        G0057870
ISN       208           DO 540 JO=1,NOS                                            G0057880
ISN       209              JEDGEJ=JEDGEJ+1                                         G0057890
ISN       210              EDGOR (JEDGEJ)=VERT                                     G0057900
ISN       211              FREDGE(JEDGEJ)=.FALSE.                                  G0057910
ISN       212              EDPARM(JEDGEJ)=BOUN                                     G0057920
ISN       213              JGRP2=JGRPO+JO                                          G0057930
ISN       214              JGRPOE(5,JEDGEJ)=NULL                                   G0057940
ISN       215              JGRPOE(2,JEDGEJ)=JGRP2                                  G0057950
ISN       216              JEDGOG(4,JGRP2) =JEDGEJ                                 G0057960
ISN       217     540   CONTINUE                                                   G0057970
                C                                                                  G0057980
ISN       218           NEDGES=JEDGEJ                                              G0057990
                CCC                                                                G0058000
                CCC        NOW CALCULATE JGRPOE(1,*),JGRPOE(3,*),JGRPOE(4,*),      G0058010
                CCC        AND JGRPOE(6,*).                                        G0058020
                CCC                                                                G0058030
                CCC        FIRST CALCULATE JADJAM, THE MODIFIED JADJAC.            G0058040
ISN       219           DO 620 JGRPJ=1,NGRPS                                       G0058050
ISN       220              DO 610 ISIDE=1,4                                        G0058060
ISN       221                 JGRPAD=JADJAC(ISIDE,JGRPJ)                           G0058070
ISN       222                 IF (JGRPAD.LE.NULL) LEXPR=.TRUE.                     G0058080
ISN       224                 IF (JGRPAD.GT.NULL)                                  G0058090
                1                LEXPR = ( LFRNT(JGRPJ).AND.LFRNT(JGRPAD).AND.    G0058100
                2                          (JTYFRN(JGRPJ).NE.JTYFRN(JGRPAD)) )    G0058110
ISN       226                 IF (.NOT.LEXPR) JADJAM(ISIDE,JGRPJ)=JGRPAD           G0058120
ISN       228                 IF (     LEXPR) JADJAM(ISIDE,JGRPJ)=JGRPJ            G0058130
ISN       230     610      CONTINUE                                                G0058140
ISN       231     620   CONTINUE                                                   G0058150
                C          NEXT CALCULATE THE JGRPOE.                              G0058160
ISN       232           DO 650 JEDGEJ=1,NEDGES                                     G0058170
                C             CALCULATE JGRPOE(1,*) AND JGRPOE(3,*).               G0058180
ISN       233              JGRP2=JGRPOE(2,JEDGEJ)                                  G0058190
ISN       234              IF (JGRP2.GT.NULL) THEN                                 G0058200
ISN       235                 IF (EDGOR(JEDGEJ).EQ.HORZ) THEN                      G0058210
ISN       236                    JGRPOE(1,JEDGEJ)=JADJAM(2,JGRP2)                  G0058220
ISN       237                    JGRPOE(3,JEDGEJ)=JADJAM(4,JGRP2)                  G0058230
                C                  JEDGOG(1,JGRP2 )=JEDGEJ  HAS ALREADY BEEN DONE. G0058240
ISN       238                 END IF                                               G0058250
ISN       239                 IF (EDGOR(JEDGEJ).EQ.VERT) THEN                      G0058260
ISN       240                    JGRPOE(1,JEDGEJ)=JADJAM(3,JGRP2)                  G0058270
ISN       241                    JGRPOE(3,JEDGEJ)=JADJAM(1,JGRP2)                  G0058280
ISN       242                 END IF                                               G0058290
ISN       243               ELSE                                                   G0058300
ISN       244                 JGRPOE(1,JEDGEJ)=NULL                                G0058310
ISN       245                 JGRPOE(3,JEDGEJ)=NULL                                G0058320
ISN       246               END IF                                                 G0058330
                C             CALCULATE JGRPOE(4,*) AND JGRPOE(6,*).               G0058340
ISN       247              JGRP5=JGRPOE(5,JEDGEJ)                                  G0058350
ISN       248              IF (JGRP5.GT.NULL) THEN                                 G0058360
ISN       249                 IF (EDGOR(JEDGEJ).EQ.HORZ) THEN                      G0058370
ISN       250                    JGRPOE(4,JEDGEJ)=JADJAM(2,JGRP5)                  G0058380
ISN       251                    JGRPOE(6,JEDGEJ)=JADJAM(4,JGRP5)                  G0058390
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                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
                C               JEDGOG(3,JGRPS )=JEDGEJ  HAS ALREADY BEEN DONE.                 G0058610
ISN      252                  END IF                                                            G0058620
ISN      253                IF (EDGOR(JEDGEJ).EQ.VERT) THEN                                     G0058630
ISN      254                   JGRPOE(4,JEDGEJ)=JADJAM(3,JGRPS)                                 G0058640
ISN      255                   JGRPOE(6,JEDGEJ)=JADJAM(1,JGRPS)                                 G0058650
ISN      256                END IF                                                            G0058660
ISN      257              ELSE                                                                G0058670
ISN      258                JGRPOE(4,JEDGEJ)=NULL                                             G0058680
ISN      259                JGRPOE(6,JEDGEJ)=NULL                                             G0058690
ISN      260              END IF                                                              G0058700
ISN      261        650 CONTINUE                                                              G0058710
                C                                                                            G0058720
ISN      262           IF (OUTP) THEN                                                         G0058730
                C                                                                            G0058740
                C                                                                            G0058750
                C             STEP 7.  PRINT OUT THE TABLES.                                 G0058760
                C                                                                            G0058770
ISN      263              900    CONTINUE                                                    G0058780
ISN      264                     NHORZ=20                                                    G0058790
ISN      265                     FORMAT('0-------------------------------------------------- G0058800
                     1 ----------------------------------------------------------')         G0058810
ISN      266              902    FORMAT(' - ')                                               G0058820
ISN      267              903    FORMAT(' -    JFP  ',2415)                                  G0058830
ISN      268              904    FORMAT(' -  EDGOR  ',24(1X,A4))                             G0058840
ISN      269              906    FORMAT(' -  EDPARM ',24(1X,A4))                             G0058850
ISN      270              907    FORMAT(' - JEDGEJ  ',2415)                                  G0058860
ISN      271              909    FORMAT(' -EDGOF(',I1,',',I2,') ',2415)                      G0058870
ISN      272              910    FORMAT(' -GRPOE(',I1,',',I2,') ',2415)                      G0058880
ISN      273              912    FORMAT(' -EDGOG(',I1,',',I2,') ',2415)                      G0058890
ISN      274              913    FORMAT(' - JGRP    ',2415)                                  G0058900
                C                                                                            G0058910
                C                THE JEDGOF TABLE.                                           G0058920
                C                                                                            G0058930
ISN      275                     WRITE(6,901)                                                G0058940
ISN      276                     DO 929 JSTA=1,NFPTOT,NHORZ                                  G0058950
ISN      277                        JFIN=JSTA+NHORZ-1                                        G0058960
ISN      278                        IF (JFIN.GT.NFPTOT) JFIN=NFPTOT                          G0058970
ISN      280                        WRITE(6,902)                                             G0058980
ISN      281                        WRITE(6,903)    (        JFP ,JFP=JSTA,JFIN)             G0058990
ISN      282                        WRITE(6,909)1,(JEDGOF(1,JFP),JFP=JSTA,JFIN)              G0059000
ISN      283                        WRITE(6,909)2,(JEDGOF(2,JFP),JFP=JSTA,JFIN)              G0059010
ISN      284              929    CONTINUE                                                    G0059020
                C                                                                            G0059030
                C                THE EDGOR, EDPARM, AND JGRPOE TABLES.                       G0059040
                C                                                                            G0059050
ISN      285                     WRITE(6,901)                                                G0059060
ISN      286                     DO 949 JSTA=1,NEDGES,NHORZ                                  G0059070
ISN      287                        JFIN=JSTA+NHORZ-1                                        G0059080
ISN      288                        IF (JFIN.GT.NEDGES) JFIN=NEDGES                          G0059090
ISN      290                        WRITE(6,902)                                             G0059100
ISN      291                        WRITE(6,907)(        JEDGEJ ,JEDGEJ=JSTA,JFIN)           G0059110
ISN      292                        WRITE(6,905)( EDGOR(JEDGEJ),JEDGEJ=JSTA,JFIN)           G0059120
ISN      293                        WRITE(6,906)(EDPARM(JEDGEJ),JEDGEJ=JSTA,JFIN)           G0059130
ISN      294                        DO 947 ISIDE=1,4                                        G0059140
ISN      295                           WRITE(6,910)ISIDE,(JGRPOE(ISIDE,JEDGEJ),JEDGEJ=JSTA,JFIN)G0059150
ISN      296              947       CONTINUE                                                G0059160
ISN      297              949    CONTINUE                                                    G0059170
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                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
                C                                                                            G0059180
                C                THE JEDGOG TABLE.                                           G0059190
                C                                                                            G0059200
ISN      298                     WRITE(6,901)                                                G0059210
ISN      299                     DO 959 JSTA=1,NGRPS,NHORZ                                   G0059220
ISN      300                        JFIN=JSTA+NHORZ-1                                        G0059230
ISN      301                        IF (JFIN.GT.NGRPS) JFIN=NGRPS                            G0059240
ISN      303                        WRITE(6,902)                                             G0059250
ISN      304                        WRITE(6,913)                                             G0059260
ISN      305                        DO 957 JDIR=1,NDIRS                (JGRPJ ,JGRPJ=JSTA,JFIN)G0059270
ISN      306                           WRITE(6,912)JDIR,(JEDGOG(JDIR,JGRPJ),JGRPJ=JSTA,JFIN)G0059280
ISN      307              957       CONTINUE                                                G0059290
ISN      308              959    CONTINUE                                                    G0059300
ISN      309                     WRITE(6,901)                                                G0059310
ISN      310                  END IF                                                         G0059320
                C                                                                            G0059330
ISN      311                RETURN                                                          G0059340
ISN      312                END                                                             G0059350
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STATISTICS SOURCE STATEMENTS = 297, PROGRAM SIZE = 12872 BYTES, PROGRAM NAME = EDGGN1 PAGE: 117.

STATISTICS NO DIAGNOSTICS GENERATED.

EDGGN1 END OF COMPILATION 24 ******

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                 *....*...1.........2.........3.........4.........5.........6.........7.*.......8

ISN      152                FREDGE(JEDGEJ)=.FALSE.                                          G0057290
ISN      153                EDPARM(JEDGEJ)=INTR                                             G0057300
ISN      154                IF (JR.EQ.MRFP) THEN                                            G0057310
ISN      155                   JGRP5=JGRPO+JO+NOS                                           G0057320
ISN      156                   JGRP2=JGRP5-NOS                                              G0057330
ISN      157                   JEDGOG(2,JGRP2)=JEDGEJ                                       G0057340
ISN      158                 ELSE                                                           G0057350
ISN      159                   JGRP5=JGRPO+JO                                               G0057360
ISN      160                   JGRP2=JGRP5-NOS                                              G0057370
ISN      161                   JEDGOG(4,JGRP2)=JEDGEJ                                       G0057380
ISN      162                   JEDGOG(2,JGRP5)=JEDGEJ                                       G0057390
ISN      163                 END IF                                                         G0057400
ISN      164                JGRPOE(2,JEDGEJ)=JGRP2                                          G0057410
ISN      165                JGRPOE(5,JEDGEJ)=JGRP5                                          G0057420
ISN      166    460     CONTINUE                                                           G0057430
                C              NOW FOR THE HORIZONTAL EDGES.                               G0057440
ISN      167                DO 480 JO=1,NOS                                                 G0057450
ISN      168                JEDGEJ=JEDGEJ+1                                                 G0057460
ISN      169                EDGOR(JEDGEJ)=HORZ                                              G0057470
ISN      170                FREDGE(JEDGEJ)=.FALSE.                                          G0057480
ISN      171                IF (.NOT.L2SYMM) THEN                                           G0057490
ISN      172                   EDPARM(JEDGEJ)=INTR                                          G0057500
ISN      173                   JGRP2=JGRPO+JO                                               G0057510
ISN      174                   IF (JO.LT.NOS) JGRP5=JGRP2+1                                 G0057520
ISN      176                   IF (JO.EQ.NOS) JGRP5=JGRPO+1                                 G0057530
ISN      178                 END IF                                                         G0057540
ISN      179                IF (L2SYMM) THEN                                                G0057550
ISN      180                   JGRP5=JGRPO+JO                                               G0057560
ISN      181                   IF (JO.EQ.1) THEN                                            G0057570
ISN      182                      EDPARM(JEDGEJ)=AXIS                                       G0057580
ISN      183                      JGRP2=NULL                                                G0057590
ISN      184                    ELSE                                                        G0057600
ISN      185                      EDPARM(JEDGEJ)=INTR                                       G0057610
ISN      186                      JGRP2=JGRP5-1                                             G0057620
ISN      187                    END IF                                                      G0057630
ISN      188                 END IF                                                         G0057640
ISN      189                JGRPOE(2,JEDGEJ)=JGRP2                                          G0057650
ISN      190                IF (JGRP2.GT.NULL) JEDGOG(1,JGRP2)=JEDGEJ                       G0057660
ISN      192                JGRPOE(5,JEDGEJ)=JGRP5                                          G0057670
ISN      193                IF (JGRP5.GT.NULL) JEDGOG(3,JGRP5)=JEDGEJ                       G0057680
ISN      195    480     CONTINUE                                                           G0057690
                C              IF L2SYMM IS  TRUE, THEN THERE ARE NOS+1 EDGES.             G0057700
                C              IF L2SYMM IS FALSE, THEN THERE ARE ONLY NOS EDGES.          G0057710
                C              THEREFORE:                                                  G0057720
ISN      196                IF (L2SYMM) THEN                                                G0057730
ISN      197                   JEDGEJ=JEDGEJ+1                                              G0057740
ISN      198                   EDGOR (JEDGEJ)=HORZ                                          G0057750
ISN      199                   FREDGE(JEDGEJ)=.FALSE.                                       G0057760
ISN      200                   EDPARM(JEDGEJ)=AXIS                                          G0057770
ISN      201                   JGRP2=JGRPO+NOS                                              G0057780
ISN      202                   JGRPOE(5,JEDGEJ)=NULL                                        G0057790
ISN      203                   JGRPOE(2,JEDGEJ)=JGRP2                                       G0057800
ISN      204                   JEDGOG(1,JGRP2 )=JEDGEJ                                      G0057810
ISN      205                 END IF                                                         G0057820
ISN      206    490 CONTINUE                                                               G0057830
                C                                                                          G0057840
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                 *....*...1.........2.........3.........4.........5.........6.........7.*.......8

                C          THE OUTSIDE BOUNDARY EDGES.                                     G0057850
                C                                                                          G0057860
ISN      207           JGRPO=1+(NRS-2)*NOS                                                 G0057870
ISN      208           DO 540 JO=1,NOS                                                     G0057880
ISN      209              JEDGEJ=JEDGEJ+1                                                  G0057890
ISN      210              EDGOR (JEDGEJ)=VERT                                              G0057900
ISN      211              FREDGE(JEDGEJ)=.FALSE.                                           G0057910
ISN      212              EDPARM(JEDGEJ)=BOUN                                              G0057920
ISN      213              JGRP2=JGRPO+JO                                                   G0057930
ISN      214              JGRPOE(5,JEDGEJ)=NULL                                            G0057940
ISN      215              JGRPOE(2,JEDGEJ)=JGRP2                                           G0057950
ISN      216              JEDGOG(4,JGRP2) =JEDGEJ                                          G0057960
ISN      217    540 CONTINUE                                                               G0057970
                C                                                                          G0057980
ISN      218           NEDGES=JEDGEJ                                                       G0057990
                C                                                                          G0058000
                C                                                                          G0058010
                C          NOW CALCULATE JGRPOE(1,*),JGRPOE(3,*),JGRPOE(4,*),              G0058020
                C          AND JGRPOE(6,*).                                                G0058030
                C                                                                          G0058040
                C          FIRST CALCULATE JADJAM, THE MODIFIED JADJAC.                    G0058050
ISN      219           DO 620 JGRPJ=1,NGRPS                                                G0058060
ISN      220              DO 610 ISIDE=1,4                                                 G0058070
ISN      221                 JGRPAD=JADJAC(ISIDE,JGRPJ)                                    G0058080
ISN      222                 IF (JGRPAD.LE.NULL) LEXPR=.TRUE.                              G0058090
ISN      224                 IF (JGRPAD.GT.NULL)                                           G0058100
                1              LEXPR = ( (FRNT(JGRPJ).AND.FRNT(JGRPAD).AND.               G0058110
                2                        (JTYFRN(JGRPJ).NE.JTYFRN(JGRPAD)) )             G0058120
ISN      226                 IF (.NOT.LEXPR) JADJAM(ISIDE,JGRPJ)=JGRPAD                    G0058130
ISN      228                 IF (     LEXPR) JADJAM(ISIDE,JGRPJ)=JGRPJ                     G0058140
ISN      230    610        CONTINUE                                                        G0058150
ISN      231    620     CONTINUE                                                           G0058160
                C          NEXT CALCULATE THE JGRPOE.                                      G0058170
ISN      232           DO 650 JEDGEJ=1,NEDGES                                              G0058180
                C             CALCULATE JGRPOE(1,*) AND JGRPOE(3,*).                       G0058190
ISN      233              JGRP2=JGRPOE(2,JEDGEJ)                                           G0058200
ISN      234              IF (JGRP2.GT.NULL) THEN                                          G0058210
ISN      235                 IF (EDGOR(JEDGEJ).EQ.HORZ) THEN                               G0058220
ISN      236                    JGRPOE(1,JEDGEJ)=JADJAM(2,JGRP2)                           G0058230
ISN      237                    JGRPOE(3,JEDGEJ)=JADJAM(4,JGRP2)                           G0058240
                C                  JEDGOG(1,JGRP2 )=JEDGEJ  HAS ALREADY BEEN DONE.      G0058250
ISN      238                 END IF                                                        G0058260
ISN      239                 IF (EDGOR(JEDGEJ).EQ.VERT) THEN                               G0058270
ISN      240                    JGRPOE(1,JEDGEJ)=JADJAM(3,JGRP2)                           G0058280
ISN      241                    JGRPOE(3,JEDGEJ)=JADJAM(1,JGRP2)                           G0058290
ISN      242                 END IF                                                        G0058300
ISN      243               ELSE                                                          G0058310
ISN      244                 JGRPOE(1,JEDGEJ)=NULL                                       G0058320
ISN      245                 JGRPOE(3,JEDGEJ)=NULL                                       G0058330
ISN      246               END IF                                                        G0058340
                C             CALCULATE JGRPOE(4,*) AND JGRPOE(6,*).                       G0058350
ISN      247              JGRP5=JGRPOE(5,JEDGEJ)                                           G0058360
ISN      248              IF (JGRP5.GT.NULL) THEN                                          G0058370
ISN      249                 IF (EDGOR(JEDGEJ).EQ.HORZ) THEN                               G0058380
ISN      250                    JGRPOE(4,JEDGEJ)=JADJAM(2,JGRP5)                           G0058390
ISN      251                    JGRPOE(6,JEDGEJ)=JADJAM(4,JGRP5)                           G0058400
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                 *....*...1.....2.....3.....4.....5.....6.....7.*.....8
                 C
ISN      252                JEDGOG(3,JGRP5 )=JEDGEJ  HAS ALREADY BEEN DONE.                GG058610
ISN      253              END IF                                                          GG058420
ISN      254              IF (EDGOR(JEDGEJ).EQ.VERT) THEN                                 GG058430
ISN      255                JGRPOE(4,JEDGEJ)=JADJAM(3,JGRP5)                              GG058440
ISN      256                JGRPOE(6,JEDGEJ)=JADJAM(1,JGRP5)                              GG058450
ISN      257              END IF                                                          GG058460
ISN      258            ELSE                                                            GG058470
ISN      259              JGRPOE(4,JEDGEJ)=NULL                                         GG058480
ISN      260              JGRPOE(6,JEDGEJ)=NULL                                         GG058490
ISN      261            END IF                                                          GG058500
                  650 CONTINUE                                                         GG058510
                 C                                                                     GG058520
ISN      262         IF (OUTP) THEN                                                    GG058530
                 C                                                                     GG058540
                 C        STEP 7.  PRINT OUT THE TABLES.                               GG058550
                 C                                                                     GG058560
ISN      263       900   CONTINUE                                                      GG058570
ISN      264             NHORZ=20                                                      GG058580
ISN      265             901   FORMAT('0------------------------------------------------GG058590
                     '------------------------------------------------------------')GG058600
ISN      266             902   FORMAT(' - ')                                           GG058610
ISN      267             903   FORMAT(' -     JFP  ',24I5)                             GG058620
ISN      268             905   FORMAT(' -  EDGOR  ',24(1X,A4))                         GG058630
ISN      269             906   FORMAT(' -  EDPARM ',24(1X,A4))                         GG058640
ISN      270             907   FORMAT(' -JEDGEJ   ',24I5)                              GG058650
ISN      271             909   FORMAT(' -EDGOF(',I1,',  ',24I5)                      GG058660
ISN      272             910   FORMAT(' -GRPOE(',I1,',  ',24I5)                      GG058670
ISN      273             912   FORMAT(' -EDGOG(',I1,',  ',24I5)                      GG058680
ISN      274             913   FORMAT(' - JGRP    ',24I5)                            GG058690
                 C                                                                     GG058700
                 C        THE JEDGOF TABLE.                                            GG058710
                 C                                                                     GG058720
ISN      275             WRITE(6,901)                                                  GG058730
ISN      276             DO 929 JSTA=1,NFPTOT,NHORZ                                    GG058740
ISN      277               JFIN=JSTA+NHORZ-1                                           GG058750
ISN      278               IF (JFIN.GT.NFPTOT) JFIN=NFPTOT                             GG058760
ISN      280               WRITE(6,902)                                                GG058770
ISN      281               WRITE(6,903)(    JFP ,JFP=JSTA,JFIN)                        GG058780
ISN      282               WRITE(6,909)1,(JEDGOF(1,JFP),JFP=JSTA,JFIN)                 GG058790
ISN      283               WRITE(6,909)2,(JEDGOF(2,JFP),JFP=JSTA,JFIN)                 GG058800
ISN      284       929   CONTINUE                                                      GG058810
                 C                                                                     GG058820
                 C        THE EDGOR, EDPARM, AND JGRPOE TABLES.                        GG058830
                 C                                                                     GG058840
ISN      285             WRITE(6,901)                                                  GG058850
ISN      286             DO 949 JSTA=1,NEDGES,NHORZ                                    GG058860
ISN      287               JFIN=JSTA+NHORZ-1                                           GG058870
ISN      288               IF (JFIN.GT.NEDGES) JFIN=NEDGES                             GG058880
ISN      290               WRITE(6,902)                                                GG058890
ISN      291               WRITE(6,907)(  JEDGEJ ,JEDGEJ=JSTA,JFIN)                    GG058900
ISN      292               WRITE(6,905)( EDGOR(JEDGEJ),JEDGEJ=JSTA,JFIN)               GG058910
ISN      293               WRITE(6,906)(EDPARM(JEDGEJ),JEDGEJ=JSTA,JFIN)               GG058920
ISN      294               DO 947 ISIDE=1,6,1                                          GG058930
ISN      295                 WRITE(6,910)ISIDE,(JGRPOE(ISIDE,JEDGEJ),JEDGEJ=JSTA,JFIN)GG058940
ISN      296       947     CONTINUE                                                    GG058950
ISN      297       949   CONTINUE                                                      GG058960
```



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                 *....*...1.....2.....3.....4.....5.....6.....7.*.....8
                 C                                                                     GG058970
                 C        THE JEDGOG TABLE.                                            GG058980
                 C                                                                     GG058990
ISN      298             WRITE(6,901)                                                  GG059000
ISN      299             DO 959 JSTA=1,NGRPS,NHORZ                                     GG059010
ISN      300               JFIN=JSTA+NHORZ-1                                           GG059020
ISN      301               IF (JFIN.GT.NGRPS) JFIN=NGRPS                               GG059030
ISN      303               WRITE(6,902)                                                GG059040
ISN      304               WRITE(6,913)(  JGRPJ ,JGRPJ=JSTA,JFIN)                      GG059050
ISN      305               DO 957 JDIR=1,NDIRS                                         GG059060
ISN      306                 WRITE(6,912)JDIR,(JEDGOG(JDIR,JGRPJ),JGRPJ=JSTA,JFIN)    GG059070
ISN      307       957     CONTINUE                                                    GG059080
ISN      308       959   CONTINUE                                                      GG059090
ISN      309             WRITE(6,901)                                                  GG059100
ISN      310           END IF                                                          GG059110
                 C                                                                     GG059120
ISN      311         RETURN                                                            GG059130
ISN      312         END                                                               GG059140
```

STATISTICS SOURCE STATEMENTS = 297, PROGRAM SIZE = 12872 BYTES, PROGRAM NAME = EDGGN1 PAGE: 117.

STATISTICS NO DIAGNOSTICS GENERATED.

EDGGN1 END OF COMPILATION 24 **********

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OPTIONS IN EFFECT:  NOLIST NOMAP NOXREF NOGOSTMT NODECK   SOURCE   TERM NOOBJECT FIXED  NOTEST   TRMFLG   SRCFLG
                    NOSYM NOREENT   SDUMP AUTODBL(NONE)   NOSXM    IL
                      OPT(0) LANGLVL(77) NOFIPS   FLAG(I)  NAME(MAIN  )  LINECOUNT(60)      CHARLEN(500)

                 *....*...1.........2.........3.........4.........5.........6.........7.*........8
                 C.EDGGN2                                                                          GOOS9150
                 C                                                                                 GOOS9160
                 CC  500.  CALCULATE THE SECOND SET OF EDGE TABLES.                                GOOS9170
                 C                                                                                 GOOS9180
ISN         1            SUBROUTINE EDGGN2(OUTP,NGRPMX,NEFCMX,NEDGMX,JORIEN,                    GOOS9190
                1                      NEFECS,NIEDGS,JIEFEC,JIEDGE,JIGRUP,EDGOR)                  GOOS9200
ISN         2            IMPLICIT DOUBLE PRECISION (A-H,K,O-Z)                                   GOOS9210
                 C                                                                                 GOOS9220
ISN         3            CHARACTER*4 JORIEN(8),EDGOR(NEDGMX)                                     GOOS9230
ISN         4            LOGICAL OUTP,LEXPR,LODIT,LAFECD(55)                                     GOOS9240
ISN         5            INTEGER JIEFEC(NGRPMX),NIEDGS(NGRPMX)                                   GOOS9250
ISN         6            INTEGER JIGRUP(NEFCMX),JIEDGE(NEFCMX)                                   GOOS9260
ISN         7            INTEGER JRGRUP(825),JREDGE(825)                                         GOOS9270
ISN         8            INTEGER OTHSID(150)                                                     GOOS9280
                 C                                                                                 GOOS9290
ISN         9            LOGICAL COORTR,TRACKF,OVTAKE,DATAFR,RESTRT                              GOOS9300
ISN        10            INTEGER FPJX,FPJV                                                       GOOS9310
ISN        11            LOGICAL LFRNT                                                           GOOS9320
ISN        12            INTEGER EDSIGN                                                          GOOS9330
ISN        13            LOGICAL FREDGE,LBNDED,LNULED                                            GOOS9340
                 C                                                                                 GOOS9350
ISN        14            COMMON/GRIPRO/DT,DXFRNT,DISXM,DX(57),DISTX(58),MFRONT,NBLOKS,           GOOS9360
                1                  NG,NJAY,COORTR,TRACKF,OVTAKE,DATAFR,RESTRT                     GOOS9370
ISN        15            COMMON/IBASCS/NULL                                                      GOOS9380
ISN        16            COMMON/FRONT1/NFPTOT,FPJX(16),FPJV(16)                                  GOOS9390
ISN        17            COMMON/TABLS1/NBLKS,NGRPS,JGRPOG(50),JAGPOF(9,16),                      GOOS9400
                1                  JBLK(55),JFPT(55)                                              GOOS9410
ISN        18            COMMON/TABL1A/LFRNT(55)                                                 GOOS9420
ISN        19            COMMON/EDSMAL/NDIRS,NEDGES,EDSIGN(8)                                    GOOS9430
ISN        20            COMMON/EDLOGC/FREDGE(150),LBNDED(150),LNULED(150)                       GOOS9440
ISN        21            COMMON/EDTOE2/JGRPOE(6,150),JDIROE(2,150)                               GOOS9450
ISN        22            COMMON/EDTOF /JEDGOF(2,16),JPEDHD(16),JPEDVE(16)                        GOOS9460
ISN        23            COMMON/ADJACN/IFORML,JUPGRP(16),JADJAC(4,55)                            GOOS9470
ISN        24            COMMON/TABLS2/NRLGS,JGRPOF(16),JRLG(55),JGRPOR(54),                     GOOS9480
                1                  JGPTNR(55),JTYFRN(55),JTYAFL(55),JRFLIN(55)                    GOOS9490
                 C                                                                                 GOOS9500
                 CC  INPUT SCALARS: NGRPS,NEDGES                                                   GOOS9510
                 CC  INPUT  ARRAYS: JEDGOF,JGRPOE,JDIROE,JORIEN                                    GOOS9520
                 CC  LOCAL  ARRAY : OTHSID                                                         GOOS9530
                 CC  OUTPUT SCALAR: NEFECS                                                         GOOS9540
                 CC                                                                                GOOS9550
                 CC                                                                                GOOS9560
                 CC        A FORMAT SIMILAR TO THE YALE SPARSE FORMAT IS USED.                     GOOS9570
                 CC        DIMENSIONS: JGRPOE(1-4,NEDGES),EDGOR(NEDGES),JEFEC OMARK              GOOS9580
                 CC        DIMENSIONS: JIEDGE(NEFECS),JIEFEC(NGRPS),NIEDGS(NGRPS)                GOOS9590
                 C                                                                                 GOOS9600
ISN        25            DO 710 JGRPJ=1,NGRPS                                                    GOOS9610
ISN        26            NIEDGS(JGRPJ)=0                                                         GOOS9620
ISN        27            LAFECD(JGRPJ)=.FALSE.                                                   GOOS9630
ISN        28       710 CONTINUE                                                                 GOOS9640
                 C                                                                                 GOOS9650
ISN        29            DO 712 JEDGEJ=1,NEDGES                                                  GOOS9660
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                 *....*...1.........2.........3.........4.........5.........6.........7.*........8
ISN        30            IF (.NOT.FREDGE(JEDGEJ)) OTHSID(JEDGEJ)=NULL                            GOOS9670
ISN        32       712 CONTINUE                                                                 GOOS9680
ISN        33            DO 716 JFP=1,NFPTOT                                                     GOOS9690
ISN        34               JEDGE1=JEDGOF(1,JFP)                                                 GOOS9700
ISN        35               IF (COORTR) THEN                                                     GOOS9710
                 C                  IF JFP > NOS, THEN JEDGE1, JEDGE2, AND OTHSID               GOOS9720
                 C                  ARE THE SAME AS FOR JFP-NOS.                                GOOS9730
ISN        36                  JEDGE2=JEDGOF(2,JFP)                                             GOOS9740
ISN        37                  OTHSID(JEDGE1)=JEDGE2                                            GOOS9750
ISN        38                  OTHSID(JEDGE2)=JEDGE1                                            GOOS9760
ISN        39                ELSE                                                               GOOS9770
ISN        40                  OTHSID(JEDGE1-1)=JEDGE1+1                                        GOOS9780
ISN        41                  OTHSID(JEDGE1+1)=JEDGE1-1                                        GOOS9790
ISN        42                  OTHSID(JEDGE1  )=JEDGE1+2                                        GOOS9800
ISN        43                  OTHSID(JEDGE1+2)=JEDGE1                                          GOOS9810
ISN        44                END IF                                                             GOOS9820
ISN        45       716 CONTINUE                                                                 GOOS9830
                 C                                                                             GOOS9840
ISN        46            IF (COORTR) THEN                                                        GOOS9850
ISN        47              ISDSTA=1                                                              GOOS9860
ISN        48              ISDFIN=6                                                              GOOS9870
ISN        49              ISDINC=1                                                              GOOS9880
ISN        50             ELSE                                                                   GOOS9890
ISN        51              ISDSTA=1                                                              GOOS9900
ISN        52              ISDFIN=4                                                              GOOS9910
ISN        53              ISDINC=1                                                              GOOS9920
ISN        54             END IF                                                                 GOOS9930
                 C                                                                             GOOS9940
ISN        55            JEFECJ=0                                                              GOOS9950
ISN        56            DO 740 JEDGEJ=1,NEDGES                                                GOOS9960
ISN        57               JEFSAT=JEFECJ+1                                                    GOOS9970
ISN        58               DO 720 ISIDE=ISDSTA,ISDFIN,ISDINC                                  GOOS9980
                 C                  I.E. EITHER DO 720 ISIDE=1,6,1 OR DO 720 ISIDE=1,4,1       GOOS9990
ISN        59                  JGRPJ=JGRPOE(ISIDE,JEDGEJ)                                      GOOS0000
ISN        60                  IF (JGRPJ.GT.NULL) THEN                                         GOOS0010
                 C                     THE DUPLICATE GROUP-EDGE EFFECTS                        GOOS0020
                 C                     WILL BE CLEANED UP BELOW.                               GOOS0030
ISN        61                     JEFECJ=JEFECJ+1                                              GOOS0040
ISN        62                     JIEDGE(JEFECJ)=JEDGEJ                                        GOOS0050
ISN        63                     JRGRUP(JEFECJ)=JGRPJ                                         GOOS0060
ISN        64                     NIEDGS(JGRPJ)=NIEDGS(JGRPJ)+1                                GOOS0070
ISN        65                     IF (COORTR.AND.LFRNT(JGRPJ)) THEN                            GOOS0080
ISN        66                        JGRP2=JGPTNR(JGRPJ)                                       GOOS0090
ISN        67                        JEFECJ=JEFECJ+1                                           GOOS0100
ISN        68                        JIEDGE(JEFECJ)=JEDGEJ                                     GOOS0110
ISN        69                        JRGRUP(JEFECJ)=JGRP2                                      GOOS0120
ISN        70                        NIEDGS(JGRP2)=NIEDGS(JGRP2)+1                             GOOS0130
ISN        71                     END IF                                                       GOOS0140
ISN        72                  END IF                                                          GOOS0150
ISN        73       720     CONTINUE                                                           GOOS0160
ISN        74               IF (FREDGE(JEDGEJ)) THEN                                           GOOS0170
ISN        75                  JEDGE2=OTHSID(JEDGEJ)                                           GOOS0180
ISN        76                  DO 724 ISIDE=ISDSTA,ISDFIN,ISDINC                               GOOS0190
                 C                  I.E. EITHER DO 724 ISIDE=1,6,1 OR DO 724 ISIDE=1,4,1       GOOS0200
ISN        77                     JGRPJ=JGRPOE(ISIDE,JEDGE2)                                   GOOS0210
ISN        78                     IF (JGRPJ.GT.NULL) THEN                                      GOOS0220
```

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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
                C                     THE DUPLICATE GROUP-EDGE EFFECTS                          G0060230
                C                     WILL BE CLEANED UP BELOW.                                 G0060240
ISN      79                         JEFECJ=JEFECJ+1                                            G0060250
ISN      80                         JREDGE(JEFECJ)=JEDGEJ                                      G0060260
                C                                (NOT JEDGE2)                                    G0060270
ISN      81                         JRGRUP(JEFECJ)=JGRPJ                                       G0060280
ISN      82                         NIEDGS(JGRPJ)=NIEDGS(JGRPJ)+1                              G0060290
ISN      83                       END IF                                                       G0060300
ISN      84           724       CONTINUE                                                      G0060310
ISN      85                   END IF                                                          G0060320
                C                 THE PURPOSE OF THIS EXTRA SECTION IS TO INCLUDE THE        G0060330
                C                 "EXTRA" GROUP-EDGE EFFECTS IN WHICH A (BOUNDARY) FRONT GROUPG0060340
                C                 AFFECTS THE FLFR OF A NEARBY NON-NEIGHBOUR (BOUNDARY) EDGE, G0060350
                C                 (PROVIDED THAT COORTR IS FALSE).                           G0060360
                C                 IF COORTR IS TRUE, THEN LBNDED IS UNDEFINED.  THEREFORE,   G0060370
                C                 THREE IF STATEMENTS ARE USED INSTEAD OF ONE.               G0060380
ISN      86                   IF (COORTR) LDOIT=.FALSE.                                     G0060390
ISN      88                   IF (.NOT.COORTR) LDOIT=LBNDED(JEDGEJ)                         G0060400
ISN      90                   IF (LDOIT) THEN                                               G0060410
ISN      91                     DO 728 ISIDE=1,2                                            G0060420
ISN      92                       JGRPJ=JGRPOF(ISIDE,JEDGEJ)                                G0060430
ISN      93                       IF (JGRPJ.GT.NULL) THEN                                   G0060440
                C                                IF THE GROUP IS NON-NULL, IT IS AUTOMATICALLY A G0060450
                C                                BOUNDARY BLOCK GROUP.  NO FURTHER TEST IS NEEDED. G0060460
ISN      94                         DO 726 ISIDG=1,4                                        G0060470
ISN      95                           JGRPAD=JADJAC(ISIDG,JGRPJ)                            G0060480
ISN      96                           IF (JGRPAD.GT.NULL) THEN                              G0060490
ISN      97                             IF (LFRNT(JGRPAD)) THEN                             G0060500
                C                                  STRICTLY SPEAKING, THE GROUP-EDGE EFFECT  G0060510
                C                                  SHOULD BE CONSIDERED ONLY IF THE          G0060520
                C                                  FRONT GROUP IS ON THE BOUNDARY.  HOWEVER, G0060530
                C                                  IT SEEMS SAFER TO INTRODUCE A FEW SPURIOUSG0060540
                C                                  GROUP-EDGE EFFECTS, WHICH MAY ONE DAY     G0060550
                C                                  BE NO LONGER SPURIOUS, THAN TO IMPLEMENT  G0060560
                C                                  MORE PRECISE TESTS WHICH FAIL IF THERE AREG0060570
                C                                  MORE THAN ONE STEAM FRONT.                G0060580
                C                                  THE DUPLICATE GROUP-EDGE EFFECTS          G0060590
                C                                  WILL BE CLEANED UP BELOW.                 G0060600
ISN      98                               JEFECJ=JEFECJ+1                                   G0060610
ISN      99                               JREDGE(JEFECJ)=JEDGEJ                             G0060620
ISN     100                               JRGRUP(JEFECJ)=JGRPAD                             G0060630
                C                                  (NOT JGRPJ)                               G0060640
ISN     101                               NIEDGS(JGRPAD)=NIEDGS(JGRPAD)+1                   G0060650
ISN     102                             END IF                                              G0060660
ISN     103                           END IF                                                G0060670
ISN     104           726           CONTINUE                                                G0060680
ISN     105                       END IF                                                    G0060690
ISN     106           728       CONTINUE                                                    G0060700
ISN     107                   END IF                                                        G0060710
                C                 CLEAN UP THE DUPLICATE GROUP-EDGE EFFECTS FOR THIS EDGE.  G0060720
ISN     108                   JEFCLN=JEFSBT-1                                             G0060730
ISN     109                   DO 734 JEF=JEFSBT,JEFECJ                                    G0060740
ISN     110                     JGRPJ=JRGRUP(JEF)                                         G0060750
ISN     111                     IF (.NOT.LAFECD(JGRPJ)) NIEDGS(JGRPJ)=NIEDGS(JGRPJ)-1     G0060760
ISN     113                     IF (.NOT.LAFECD(JGRPJ)) THEN                              G0060770
ISN     114                       LAFECD(JGRPJ)=.TRUE.                                    G0060780
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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
ISN     115                       JEFCLN=JEFCLN+1                                           G0060790
ISN     116                       JREDGE(JEFCLN)=JREDGE(JEF)                                G0060800
ISN     117                       JRGRUP(JEFCLN)=JRGRUP(JEF)                                G0060810
ISN     118                     END IF                                                      G0060820
ISN     119           734     CONTINUE                                                      G0060830
ISN     120                   JEFECJ=JEFCLN                                                 G0060840
                C                 NOW RESTORE LAFECD, TO PREPARE IT FOR THE NEXT EDGE.      G0060850
ISN     121                   DO 736 JEF=JEFSBT,JEFCLN                                      G0060860
ISN     122                     JGRPJ=JRGRUP(JEF)                                           G0060870
ISN     123                     LAFECD(JGRPJ)=.FALSE.                                       G0060880
ISN     124           736     CONTINUE                                                      G0060890
ISN     125           740 CONTINUE                                                        G0060900
ISN     126                   NEFECS=JEFECJ                                                 G0060910
ISN     127                   J1EFEC(1)=1                                                   G0060920
                C                                                                           G0060930
ISN     128                   DO 745 JGRPJ=2,NGRPS                                          G0060940
ISN     129                     J1EFEC(JGRPJ)=J1EFEC(JGRPJ-1)+NIEDGS(JGRPJ-1)             G0060950
ISN     130           745 CONTINUE                                                        G0060960
                C                                                                           G0060970
ISN     131                   DO 750 JEFECJ=1,NEFECS                                        G0060980
ISN     132                     JGRPJ=JRGRUP(JEFECJ)                                        G0060990
ISN     133                     JEFFJ=J1EFEC(JGRPJ)                                         G0061000
ISN     134                     JIEDGE(JEFFJ)=JREDGE(JEFECJ)                                G0061010
ISN     135                     JIGRUP(JEFFJ)=JGRPJ                                         G0061020
ISN     136                     J1EFEC(JGRPJ)=JEFFJ+1                                       G0061030
ISN     137           750 CONTINUE                                                        G0061040
ISN     138                   NGRPP1=NGRPS+1                                                G0061050
                C                                                                           G0061060
ISN     139                   DO 760 JINDEX=1,NGRPS                                         G0061070
ISN     140                     JGRPJ=NGRPP1-JINDEX                                         G0061080
ISN     141                     J1EFEC(JGRPJ+1)=J1EFEC(JGRPJ)                               G0061090
ISN     142           760 CONTINUE                                                        G0061100
ISN     143                   J1EFEC(1)=1                                                   G0061110
                C                                                                           G0061120
                C                 IF COORTR IS TRUE, EDGOR HAS ALREADY BEEN CALCULATED      G0061130
                C                 IN EDGGN1.  IF COORTR IS FALSE, THEN EDGOR IS CALCULATED  G0061140
                C                 IN THE FOLLOWING LOOP.                                    G0061150
ISN     144                   IF (.NOT.COORTR) THEN                                         G0061160
ISN     145                     DO 770 JEDGEJ=1,NEDGES                                      G0061170
                C                                EDGOR(JEDGEJ)=JORIEN(JDIROE(1,JEDGEJ)) DOES NOT WORK G0061180
                C                                IF JDIROE(1,JEDGEJ) IS NULL.               G0061190
ISN     144                       IDIR=JDIROE(1,JEDGEJ)                                     G0061200
ISN     147                       IF (IDIR.EQ.NULL) IDIR=JDIROE(2,JEDGEJ)                   G0061210
ISN     149                     EDGOR(JEDGEJ)=JORIEN(IDIR)                                  G0061220
ISN     150           770   CONTINUE                                                        G0061230
ISN     151                 END IF                                                        G0061240
ISN     152               IF (OUTP) THEN                                                  G0061250
                C                                                                           G0061260
                C                   PRINT OUT THE TABLES.                                   G0061270
                C                                                                           G0061280
ISN     153           900     CONTINUE                                                      G0061290
ISN     154                   WHDR2=29                                                      G0061300
ISN     155           901     FORMAT('0',                                                   G0061310
                             1'------------------------------------------------------------G0061320
ISN     156           902     FORMAT(' - ')                                                 G0061330
ISN     157           907     FORMAT(' -JEDGEJ   ',30I4)                                    G0061340
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                    *....*...1.........2.........3.........4.........5.........6.........7.*.......8
ISN       158         914    FORMAT(' -JEFECJ   ',3014)                                          GD061350
ISN       159         915    FORMAT(' -JIGRUP   ',3014)                                          GD061360
ISN       160         916    FORMAT(' -JIEDGE   ',3014)                                          GD061370
ISN       161         917    FORMAT(' - JGRPJ   ',3014)                                          GD061380
ISN       162         918    FORMAT(' -J1EFEC   ',3014)                                          GD061390
ISN       163         919    FORMAT(' -NIEDGS   ',3014)                                          GD061400
ISN       164         920    FORMAT(' - EDGOR   ',30A4)                                          GD061410
ISN       165         921    FORMAT(' -OTHSID   ',3014)                                          GD061420
                    C                                                                           GD061430
                    C        THE JIGRUP AND JIEDGE TABLES.                                      GD061440
                    C                                                                           GD061450
ISN       166               WRITE(6,901)                                                        GD061460
ISN       167               DO 969 JSTA=1,NEFECS,NHORZ                                          GD061470
ISN       168                  JFIN=JSTA+NHORZ-1                                                GD061480
ISN       169                  IF (JFIN.GT.NEFECS) JFIN=NEFECS                                  GD061490
ISN       171                  WRITE(6,902)                                                     GD061500
ISN       172                  WRITE(6,914)(        JEFECJ ,JEFECJ=JSTA,JFIN)                   GD061510
ISN       173                  WRITE(6,915)(JIGRUP(JEFECJ),JEFECJ=JSTA,JFIN)                    GD061520
ISN       174                  WRITE(6,916)(JIEDGE(JEFECJ),JEFECJ=JSTA,JFIN)                    GD061530
ISN       175         969    CONTINUE                                                            GD061540
                    C                                                                           GD061550
                    C        THE J1EFEC AND NIEDGS TABLES.                                      GD061560
                    C                                                                           GD061570
ISN       176               WRITE(6,901)                                                        GD061580
ISN       177               DO 979 JSTA=1,NGRPS,NHORZ                                           GD061590
ISN       178                  JFIN=JSTA+NHORZ-1                                                GD061600
ISN       179                  IF (JFIN.GT.NGRPS) JFIN=NGRPS                                    GD061610
ISN       181                  WRITE(6,902)                                                     GD061620
ISN       182                  WRITE(6,917)(        JGRPJ ,JGRPJ=JSTA,JFIN)                     GD061630
ISN       183                  WRITE(6,918)(J1EFEC(JGRPJ),JGRPJ=JSTA,JFIN)                      GD061640
ISN       184                  WRITE(6,919)(NIEDGS(JGRPJ),JGRPJ=JSTA,JFIN)                      GD061650
ISN       185         979    CONTINUE                                                            GD061660
                    C                                                                           GD061670
                    C        THE EDGOR AND OTHSID TABLES.                                       GD061680
                    C                                                                           GD061690
ISN       186               WRITE(6,901)                                                        GD061700
ISN       187               DO 989 JSTA=1,NEDGES,NHORZ                                          GD061710
ISN       188                  JFIN=JSTA+NHORZ-1                                                GD061720
ISN       189                  IF (JFIN.GT.NEDGES) JFIN=NEDGES                                  GD061730
ISN       191                  WRITE(6,902)                                                     GD061740
ISN       192                  WRITE(6,907)(        JEDGEJ ,JEDGEJ=JSTA,JFIN)                   GD061750
ISN       193                  WRITE(6,920)( EDGOR(JEDGEJ),JEDGEJ=JSTA,JFIN)                    GD061760
ISN       194                  WRITE(6,921)(OTHSID(JEDGEJ),JEDGEJ=JSTA,JFIN)                    GD061770
ISN       195         989    CONTINUE                                                            GD061780
                    C                                                                           GD061790
ISN       196               END IF                                                              GD061800
                    C                                                                           GD061810
ISN       197            RETURN                                                                 GD061820
ISN       198            END                                                                    GD061830
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STATISTICS SOURCE STATEMENTS = 190, PROGRAM SIZE = 18680 BYTES, PROGRAM NAME = EDGGN2 PAGE: 125.

STATISTICS NO DIAGNOSTICS GENERATED.

EDGGN2 END OF COMPILATION 25 ******

OPTIONS IN EFFECT: NOLIST NOMAP NOXREF NOGOSTMT NODECK SOURCE TERM NOOBJECT FIXED NOTEST TRMFLG SRCFLG
NOSYM NORENT SDUMP AUTODBL(NONE) NOSXM IL
OPT(0) LANGLVL(77) NOFIPS FLAG(I) NAME(MAIN) LINECOUNT(60) CHARLEN(500)

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                    *....*...1.........2.........3.........4.........5.........6.........7.*.......8
                    C.SRCUPD                                                                    GD061840
                    C                                                                           GD061850
                    C  SOO.  UPDATE THE INTEGER PARAMETERS OF THE SOURCE TERM LOCATIONS.         GD061860
                    C                                                                           GD061870
ISN         1           SUBROUTINE SRCUPD(ALMELS,LCNEAR,LCIENT,IMLSTA,IMLFIN,                   GD061880
                   1                      NMELMX,NDIRMX,NGRPMX,                                GD061890
                   2                      LNEMNR,LMELL,JGNEAR,JMELOG,                          GD061900
                   3                      IENTMO,IENTNR,JGPSC,                                 GD061910
                   4                      ITABL,IERR)                                          GD061920
ISN         2           IMPLICIT DOUBLE PRECISION (A-H,O-Z)                                     GD061930
                    C                                                                           GD061940
ISN         3           LOGICAL OUTP                                                            GD061950
ISN         4           LOGICAL ALMELS,LCNEAR,LCIENT,LNEMNR(NMELMX),LMELL(NGRPMX)               GD061960
ISN         5           INTEGER JGNEAR(NMELMX),JMELOG(NGRPMX),JGPSC(NDIRMX,NMELMX)              GD061970
ISN         6           INTEGER IENTMO(NMELMX),IENTNR(NMELMX)                                   GD061980
                    C                                                                           GD061990
ISN         7           INTEGER EDSIGN                                                          GD062000
ISN         8           LOGICAL L2SYMM,LCIRCL                                                   GD062010
                    C                                                                           GD062020
ISN         9           COMMON/IBASCS/NULL                                                      GD062030
ISN        10           COMMON/DIMENS/NDIMNS,NX,NY,NOS,NRS,NRFM,NRFP                            GD062040
ISN        11           COMMON/TABLS1/NBLKS,NGRPS,JGRPOG(50),JAGPOF(9,16),                      GD062050
                   1                  JBLK(55),JFAT(55)                                        GD062060
ISN        12           COMMON/EDSNAL/NDIRS,NEDGES,EDSIGN(8)                                    GD062070
ISN        13           COMMON/ADJACN/IFORML,JUPGRP(16),JADJAC(4,55)                            GD062080
ISN        14           COMMON/LOGSYM/L2SYMM,LCIRCL                                             GD062090
ISN        15           COMMON/IJTBIJ/IOFGRP(55),JOFGRP(55),JGRPIJ(36,24)                       GD062100
ISN        16           COMMON/GLINEC/GLINEO(36),GLINER(24)                                     GD062110
ISN        17           COMMON/DGRID /DTHTAM(36),DTHTAP(36),DOPHHH(36),DTHETA(36),              GD062120
                   1                  DFONTH(36),DFONTP(36),                                   GD062130
                   2                  DRPHHH(24),DRADM1(24),DRADP1(24)                         GD062140
ISN        18           COMMON/FRNTCF/DCENDS,CENDIS,FRNDIS(36),DFROTH(36),FRFRTH(36),           GD062150
                   1                  YFOOTH(36),XIRING(36),YIRING(36)                         GD062160
ISN        19           COMMON/MELLXY/XMELL(11),YMELL(11)                                       GD062170
                    C                                                                           GD062180
                    C  PAGE1A                                                                   GD062190
                    C   INPUT SCALARS: LCNEAR,NGRPS,IMLSTA,IMLFIN,CENDIS,NOS                   GD062200
                    C   INPUT  ARRAYS: XMELL,YMELL,GLINEO                                      GD062210
                    C  OUTPUT SCALARS: ITABL,IERR                                               GD062220
                    C  OUTPUT  ARRAY : LMELL,IENTMO                                             GD062230
                    C                                                                           GD062240
                    C  PAGE1B                                                                   GD062250
                    C   INPUT SCALAR : NRS                                                      GD062260
                    C   INPUT  ARRAYS: FRNDIS,GLINER                                           GD062270
                    C  OUTPUT  ARRAY : IENTNR                                                   GD062280
                    C                                                                           GD062290
                    C  PAGE 2A                                                                  GD062300
                    C   INPUT SCALAR : LCIRCL                                                  GD062310
                    C   INPUT  ARRAY : JGRPIJ                                                  GD062320
                    C  OUTPUT  ARRAYS: LNEMNR,JGNEAR,LMELL,JGPSC                               GD062330
                    C                                                                           GD062340
ISN        20           OUTP=.FALSE.                                                            GD062350
```

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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
ISN       21          TOL=1.0D-12                                                          G0062360
ISN       22          IF (LCNEAR) THEN                                                     G0062370
ISN       23             DO 410 JGRPJ=1,NGRPS                                              G0062380
ISN       24                LWELL(JGRPJ)=.FALSE.                                           G0062390
ISN       25                JWELOG(JGRPJ)=NULL                                             G0062400
ISN       26    410      CONTINUE                                                          G0062410
ISN       27           END IF                                                             G0062420
                C                                                                        G0062430
ISN       28          DO 460 IWELL=IWLSTA,IWLFIN                                         G0062440
ISN       29             WLX=XWELL(IWELL)                                                G0062450
ISN       30             WLY=YWELL(IWELL)                                                G0062460
ISN       31             WLYBAR=WLY-CENDIS                                               G0062470
ISN       32             WLO=DATAN2(WLYBAR,WLX)                                          G0062480
                C              THETA VARIES BETWEEN -PI AND +PI.  DATAN2 IS A            G0062490
                C              BUILT-IN FUNCTION FOR CALCULATING ARCTAN(WLYBAR/WLX).     G0062500
                C                                                                        G0062510
                C              WE DO NOT WANT TO CALCULATE WLR, UNTIL WE KNOW IENTWO.    G0062520
                C              NEXT, CALCULATE IENTWO.  BECAUSE THE WHILE-DO CONSTRUCTION G0062530
                C              IS NOT PORTABLE, I USE GOTO STATEMENTS FOR THE TABLE-LOOKUP.G0062540
                C                                                                        G0062550
ISN       33       412   CONTINUE                                                        G0062560
ISN       34             IE=IENTWO(IWELL)                                                G0062570
ISN       35             IF (WLO.GE.GLINEO(IE)) GO TO 415                                G0062580
ISN       36             IENTWO(IWELL)=IENTWO(IWELL)-1                                   G0062590
ISN       37             IF (IENTWO(IWELL).LT.1) THEN                                    G0062600
ISN       38                GAP=GLINEO(1)-WLO                                            G0062610
ISN       39                IF (GAP.GT.TOL) THEN                                         G0062620
ISN       40                   WRITE(6,413)WLO,GLINEO(1)                                 G0062630
ISN       41    413            FORMAT(' ==>+++SRCUPD: WLO=',D26.18,' IS LESS THAN',      G0062640
                     1                 ' GLINEO(1)=',D26.18)                             G0062650
ISN       42                   ITABL=7                                                   G0062660
ISN       43                   IERR=IWELL                                                G0062670
ISN       44                   RETURN                                                    G0062680
ISN       45                ELSE                                                         G0062690
ISN       46                   IENTWO(IWELL)=1                                           G0062700
ISN       47                   GO TO 415                                                 G0062710
ISN       48                END IF                                                       G0062720
ISN       49             END IF                                                          G0062730
ISN       50          GO TO 412                                                          G0062740
ISN       51       415   CONTINUE                                                        G0062750
ISN       52             IE=IENTWO(IWELL)                                                G0062760
ISN       53             IF (WLO.LE.(GLINEO(IE)+DTHTAP(IE))) GO TO 420                   G0062770
ISN       54             IENTWO(IWELL)=IENTWO(IWELL)+1                                   G0062780
ISN       55             IF (IENTWO(IWELL).GT.NOS) THEN                                  G0062790
ISN       56                SUM=GLINEO(NOS)+DTHTAP(NOS)                                  G0062800
ISN       57                GAP=WLO-SUM                                                  G0062810
ISN       58                IF (GAP.GT.TOL) THEN                                         G0062820
ISN       59                   WRITE(6,417)WLO,SUM                                       G0062830
ISN       60    417            FORMAT(' ==>+++SRCUPD: WLO=',D26.18,' IS LARGER THAN',    G0062840
                     1                 ' GLINEO(NOS)+DTHTAP(NOS)=',D26.18)               G0062850
ISN       61                   ITABL=7                                                   G0062860
ISN       62                   IERR=IWELL                                                G0062870
ISN       63                   RETURN                                                    G0062880
ISN       64                ELSE                                                         G0062890
ISN       65                   IENTWO(IWELL)=NOS                                         G0062900
ISN       66                   GO TO 420                                                 G0062910
```



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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
ISN       67                END IF                                                     G0062920
ISN       68             END IF                                                        G0062930
ISN       69          GO TO 415                                                        G0062940
ISN       70    420   CONTINUE                                                        G0062950
                C                                                                    G0062960
                C              NOW CALCULATE WLR.                                    G0062970
ISN       71          IE=IENTWO(IWELL)                                                G0062980
ISN       72          IF (IE.LT.NOS.OR.   L2SYMM   ) IEP1=IE+1                        G0062990
ISN       74          IF (IE.EQ.NOS.AND..NOT.L2SYMM) IEP1=1                           G0063000
ISN       76          FRNDS=(FRNDIS(IE)+(FRNDIS(IEP1)-FRNDIS(IE))                     G0063010
                     1                *(WLO-GLINEO(IE))/DTHTAP(IE))                  G0063020
                C REPLACES  FRNDS=(FRNDIS(IE)+(FRNDIS(IE+1)-FRNDIS(IE))              G0063030
                C    1                *(WLO-GLINEO(IE))/(GLINEO(IE+1)-GLINEO(IE)) )  G0063040
ISN       77          WLR=OSORT(WLYBAR*WLYBAR+WLX*WLX)/FRNDS                          G0063050
                C                                                                    G0063060
                C              NEXT, CALCULATE IENTWR.  BECAUSE THE WHILE-DO CONSTRUCTION G0063070
                C              IS NOT PORTABLE, I USE GOTO STATEMENTS FOR THE TABLE-LOOKUP.G0063080
ISN       78       422   CONTINUE                                                        G0063090
ISN       79             IF (WLR.GE.GLINER(IENTWR(IWELL))) GO TO 425                     G0063100
ISN       80             IENTWR(IWELL)=IENTWR(IWELL)-1                                   G0063110
ISN       81             IF (IENTWR(IWELL).LT.1) THEN                                    G0063120
ISN       82                WRITE(6,423)WLR,GLINER(1)                                    G0063130
ISN       83    423            FORMAT(' ==>+++SRCUPD: WLR=',D26.18,' IS LESS THAN',      G0063140
                     1                 ' GLINER(1)=',D26.18)                             G0063150
ISN       84                   ITABL=8                                                   G0063160
ISN       85                   IERR=IWELL                                                G0063170
ISN       86                   RETURN                                                    G0063180
ISN       87                END IF                                                       G0063190
ISN       88             GO TO 422                                                       G0063200
ISN       89       425   CONTINUE                                                        G0063210
ISN       90             IF (WLR.LE.GLINER(IENTWR(IWELL)+1)) GO TO 430                   G0063220
ISN       91             IENTWR(IWELL)=IENTWR(IWELL)+1                                   G0063230
ISN       92             IF (IENTWR(IWELL).GE.NRS) THEN                                  G0063240
ISN       93                WRITE(6,427)WLR,GLINER(NRS)                                  G0063250
ISN       94    427            FORMAT(' ==>+++SRCUPD: WLR=',D26.18,' IS LARGER THAN',    G0063260
                     1                 ' GLINER(NRS)=',D26.18)                           G0063270
ISN       95                   ITABL=8                                                   G0063280
ISN       96                   IERR=IWELL                                                G0063290
ISN       97                   RETURN                                                    G0063300
ISN       98                END IF                                                       G0063310
ISN       99             GO TO 425                                                       G0063320
ISN      100    430   CONTINUE                                                        G0063330
                C                                                                    G0063340
ISN      101          IF (LCNEAR) THEN                                                G0063350
                C              PREPARE TO CALCULATE THE NEAREST GRID POINT.          G0063360
ISN      102             JE=IENTWR(IWELL)                                             G0063370
ISN      103             DTM=DABS(WLO-GLINEO(IE))                                     G0063380
ISN      104             DTP=DABS(WLO-GLINEO(IE)-DTHTAP(IE))                          G0063390
ISN      105             DRM =DABS(WLR-GLINER(JE))                                    G0063400
ISN      106             DRP =DABS(WLR-GLINER(JE+1))                                  G0063410
ISN      107          END IF                                                          G0063420
                C                                                                    G0063430
ISN      108          IF (LCNEAR) THEN                                                G0063440
                C              CALCULATE THE NEAREST GRID POINT.                     G0063450
ISN      109             IF (DTM.LE.DTP) INEAR=IE                                     G0063460
ISN      111             IF (DTP.LT.DTM) INEAR=IE+1                                   G0063470
```

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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
ISN      113              IF (LCIRCL.AND.INEAR.EQ.NOS+1) INEAR=1                                 G0063480
ISN      115              IF (DRM.LE.DRP) JNEAR=JE                                               G0063490
ISN      117              IF (DRP.LT.DRM) JNEAR=JE+1                                             G0063500
ISN      119              JGRPJ=JGRPIJ(INEAR,JNEAR)                                              G0063510
ISN      120              LNEMNR(IWELL)=JGRPJ.NE.JGNEAR(IWELL)                                   G0063520
ISN      121              JGNEAR(IWELL)=JGRPJ                                                    G0063530
ISN      122              JWELOG(JGRPJ)=IWELL                                                    G0063540
                C                LNEMNR IS NOW                                                  G0063550
                CCC              TRUE  IF JGNEAR WAS CHANGED BY THIS SECTION;                   G0063560
                CCC              FALSE IF JGNEAR REMAINED THE SAME.                             G0063570
ISN      123              LWELL(JGRPJ)=.TRUE.                                                    G0063580
                CCC              ALSO CALCULATE WHICH FOUR GRID POINTS                          G0063590
                CCC              RECEIVE CONTRIBUTIONS.                                         G0063600
                CCC                                                                             G0063610
                CCC              2 1                                                            G0063620
                CCC                                                                             G0063630
                CCC              3 4                                                            G0063640
                CCC                                                                             G0063650
                CCC              WE WISH TO AVOID ASKING FOR THE JADJAC OF GROUP #1.            G0063660
                CCC              THEREFORE, THERE ARE ONLY TWO WAYS TO ARRANGE                  G0063670
                CCC              THE FOLLOWING FOUR STATEMENTS.                                 G0063680
                C                WE SELECT (SOMEWHAT ARBITRARILY) ONE OF THESE TWO WAYS.        G0063690
ISN      124              JGRP4=JGRPIJ(IE,JE+1)                                                  G0063700
ISN      125              JGRP1=JADJAC(1,JGRP4)                                                  G0063710
ISN      126              JGRP3=JADJAC(2,JGRP4)                                                  G0063720
ISN      127              JGRP2=JADJAC(2,JGRP1)                                                  G0063730
ISN      128              JGPSC(1,IWELL)=JGRP1                                                   G0063740
ISN      129              JGPSC(2,IWELL)=JGRP2                                                   G0063750
ISN      130              JGPSC(3,IWELL)=JGRP3                                                   G0063760
ISN      131              JGPSC(4,IWELL)=JGRP4                                                   G0063770
ISN      132            END IF                                                                   G0063780
                C                                                                               G0063790
ISN      133      440 CONTINUE                                                                   G0063800
                C                                                                               G0063810
ISN      134          IF (OUTP) THEN                                                             G0063820
                CCC                                                                             G0063830
                CCC          PRINT OUT THE WELL TABLES.                                         G0063840
                CCC                                                                             G0063850
ISN      135      501     FORMAT(' - ')                                                          G0063860
ISN      136      502     FORMAT(' - IWLSTA=',I1,'  - IWLFIN=',I1)                               G0063870
ISN      137      503     FORMAT(' - IWELL    ',17I4)                                            G0063880
ISN      138      504     FORMAT(' - IENTMO   ',17I4)                                            G0063890
ISN      139      505     FORMAT(' - IENTMR   ',17I4)                                            G0063900
ISN      140      506     FORMAT(' - JGNEAR   ',17I4)                                            G0063910
ISN      141      507     FORMAT(' - JGRPJ    ',17I4)                                            G0063920
ISN      142      508     FORMAT(' - JWELOG   ',17I4)                                            G0063930
ISN      143      509     FORMAT(' - LNEMNR   ',17(3X,L1))                                       G0063940
ISN      144      510     FORMAT(' - LWELL    ',17(3X,L1))                                       G0063950
ISN      145      511     FORMAT(' - JGPSC(',I2,',',17I4)                                        G0063960
                C                                                                               G0063970
ISN      146              NHORZ=17                                                               G0063980
                C                                                                               G0063990
ISN      147              WRITE(6,501)                                                           G0064000
ISN      148              WRITE(6,502)IWLSTA,IWLFIN                                              G0064010
ISN      149              WRITE(6,501)                                                           G0064020
ISN      150              WRITE(6,503)(       IWL ,IWL=IWLSTA,IWLFIN)                            G0064030
```



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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
ISN      151              WRITE(6,504)(IENTMO(IWL),IWL=IWLSTA,IWLFIN)                            G0064040
ISN      152              WRITE(6,505)(IENTMR(IWL),IWL=IWLSTA,IWLFIN)                            G0064050
ISN      153              WRITE(6,506)(JGNEAR(IWL),IWL=IWLSTA,IWLFIN)                            G0064060
ISN      154              WRITE(6,509)(LNEMNR(IWL),IWL=IWLSTA,IWLFIN)                            G0064070
ISN      155              DO 530 IDIR=1,NDIRS                                                    G0064080
ISN      156                WRITE(6,511)IDIR,(JGPSC(IDIR,IWL),IWL=IWLSTA,IWLFIN)                 G0064090
ISN      157      530     CONTINUE                                                               G0064100
                C                                                                               G0064110
ISN      158              DO 540 JGSTA=1,NGRPS,NHORZ                                             G0064120
ISN      159                JGFIN=MINO(JGSTA+NHORZ-1,NGRPS)                                      G0064130
ISN      160                WRITE(6,501)                                                         G0064140
ISN      161                WRITE(6,507)(       JG ,JG=JGSTA,JGFIN)                              G0064150
ISN      162                WRITE(6,508)(JWELOG(JG),JG=JGSTA,JGFIN)                              G0064160
ISN      163                WRITE(6,510)(LWELL(JG),JG=JGSTA,JGFIN)                               G0064170
ISN      164      540     CONTINUE                                                               G0064180
                C                                                                               G0064190
ISN      165            ELSE                                                                     G0064200
ISN      166              WRITE(6,545)                                                           G0064210
ISN      167      545     FORMAT(' ',' SRCUPD WAS CALLED.  THE OUTPUT WAS SUPPRESSED.')          G0064220
ISN      168            END IF                                                                   G0064230
                C                                                                               G0064240
ISN      169          RETURN                                                                     G0064250
ISN      170          END                                                                        G0064260
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STATISTICS SOURCE STATEMENTS = 163, PROGRAM SIZE = 8316 BYTES, PROGRAM NAME = SRCUPD PAGE: 130.

STATISTICS NO DIAGNOSTICS GENERATED.

SRCUPD END OF COMPILATION 26 ******

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OPTIONS IN EFFECT:  NOLIST NOMAP NOXREF NOGOSTMT NODECK   SOURCE   TERM NOOBJECT FIXED  NOTEST   TRMFLG   SRCFLG   .
                    NOSYM NORENT   SDUMP AUTODBL(NONE)   NOSXM   IL
                      OPT(0) LANGLVL(77) NOFIPS   FLAG(I)  NAME(MAIN  )  LINECOUNT(60)      CHARLEN(500)

                 *....*...1.....2.....3.....4.....5.....6.....7.*.....8
                      C.LROUPD                                                                  G0064270
                      C                                                                         G0064280
                      CC  S00.  CALCULATE WHICH EDGES ARE IN THE ROCK.                          G0064290
                      C                                                                         G0064300
ISN         1             SUBROUTINE LROUPD(NEDGMX,LROCK)                                       G0064310
ISN         2             IMPLICIT DOUBLE PRECISION (A-H,K,O-Z)                                 G0064320
                      C                                                                         G0064330
ISN         3             LOGICAL LROCK(NEDGMX)                                                 G0064340
                      C                                                                         G0064350
ISN         4             INTEGER EDSIGN                                                        G0064360
                      C                                                                         G0064370
ISN         5             COMMON/EDSMAL/NDIRS,NEDGES,EDSIGN(8)                                  G0064380
                      CCCCC                                                                     G0064390
                      CCCCC INPUT SCALAR : NEDGES                                               G0064400
                      CCCCC OUTPUT  ARRAY : LROCK                                               G0064410
                      CCCCC                                                                     G0064420
                      CCCCC                                                                     G0064430
                      CCCCC     THIS IS RATHER SIMPLE; HOWEVER, MORE COMPLICATED VERSIONS       G0064440
                      CCCCC     MIGHT BE USED IN THE FUTURE. (1987/03/20)                       G0064450
                      C                                                                         G0064460
ISN         6             DO 150 JEDGEJ=1,NEDGES                                                G0064470
ISN         7               LROCK(JEDGEJ)=.FALSE.                                               G0064480
ISN         8           150 CONTINUE                                                            G0064490
                      C                                                                         G0064500
ISN         9             RETURN                                                                G0064510
ISN        10             END                                                                   G0064520

*STATISTICS*   SOURCE STATEMENTS = 10, PROGRAM SIZE = 780 BYTES, PROGRAM NAME = LROUPD    PAGE:  135.

*STATISTICS*    NO DIAGNOSTICS GENERATED.

**LROUPD** END OF COMPILATION 27 ******
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OPTIONS IN EFFECT:  NOLIST NOMAP NOXREF NOGOSTMT NODECK   SOURCE   TERM NOOBJECT FIXED  NOTEST   TRMFLG   SRCFLG
                    NOSYM NORENT   SDUMP AUTODBL(NONE)   NOSXM   IL
                      OPT(0) LANGLVL(77) NOFIPS   FLAG(I)  NAME(MAIN  )  LINECOUNT(60)      CHARLEN(500)

                 *....*...1.....2.....3.....4.....5.....6.....7.*.....8
                      C.CTEQNS                                                                  G0064530
                      C                                                                         G0064540
                      CC  S00.  SET UP THE LINEAR EQUATIONS FOR THE 'DISPLACEMENTS'.            G0064550
                      C                                                                         G0064560
ISN         1             SUBROUTINE CTEQNS(CONCL ,CONCV , U1D   ,SCAREA,                       G0064570
                     1                  TEST  ,NGRPMX,NFPTMX,NWELMX,NBNDMX,NBLKMX,             G0064580
                     2                  NDIRMX,NEDGMX,NCONMX,NUMAX ,NATRMX,NOMAX ,             G0064590
                     3                  NHCS  ,NCOMPS,NVARS ,NBALNS,                           G0064600
                     4                  ACCUMO,FLTMXO,FLTMYO,FLTMTO,                           G0064610
                     5                  ENHCFO,VOLCFO,FLORHO,ACUMFO,FLOMO ,                    G0064620
                     6                  GVCXHO,GVCXVO,GVCYHO,GVCYVO,                           G0064630
                     7                  DXCFLO,DYCFLO,SPLITO,SRCETO,                           G0064640
                     8                  FF2DO ,COEFFS,LCONV ,REPEAT)                           G0064650
ISN         2         IMPLICIT DOUBLE PRECISION (A-H,K,O-Z)                                     G0064660
                  C                                                                             G0064670
ISN         3         DOUBLE PRECISION U1D(NUMAX)                                               G0064680
ISN         4         DOUBLE PRECISION COEFFS(NVARS,NVARS,NCONMX)                               G0064690
ISN         5         DOUBLE PRECISION ENHCF(5,55),ENHCFO(NCOMPS,NGRPMX)                        G0064700
ISN         6         DOUBLE PRECISION VOLCF(5,55),VOLCFO(NCOMPS,NGRPMX)                        G0064710
ISN         7         DOUBLE PRECISION FF2D (5,55), FF2DO( NVARS,NGRPMX)                        G0064720
ISN         8         DOUBLE PRECISION CONCL(NCOMPS,NGRPMX),CONCV(NCOMPS,NGRPMX)                G0064730
ISN         9         DOUBLE PRECISION SCAREA(5,NFPTMX)                                         G0064740
ISN        10         INTEGER GRPLIS(55)                                                        G0064750
ISN        11         INTEGER EDGLIS(150)                                                       G0064760
ISN        12         DOUBLE PRECISION ACCUM(10,55),ACCUMO(NBALNS,NGRPMX)                       G0064770
ISN        13         DOUBLE PRECISION ACUMF(10,16),ACUMFO(NBALNS,NFPTMX)                       G0064780
ISN        14         DOUBLE PRECISION                FLOMO(NBALNS,NEDGMX)                      G0064790
ISN        15         DOUBLE PRECISION FLORH(2,150),FLORHO(   2   ,NEDGMX)                      G0064800
ISN        16         DOUBLE PRECISION FLOSUM(10),FLOTRM(10)                                    G0064810
ISN        17         LOGICAL TEST,REPEAT,LCONV(NUMAX)                                          G0064820
ISN        18         CHARACTER*6 EQCD                                                          G0064830
ISN        19         DOUBLE PRECISION FLTMXA(10,150),FLTMXO(NBALNS,NEDGMX)                     G0064840
ISN        20         DOUBLE PRECISION FLTMYA(10,150),FLTMYO(NBALNS,NEDGMX)                     G0064850
ISN        21         DOUBLE PRECISION FLTMTA(10,150),FLTMTO(NBALNS,NEDGMX)                     G0064860
ISN        22         DOUBLE PRECISION XCEN(36),YCEN(36),FLXCEN(36),FLYCEN(36)                  G0064870
ISN        23         DOUBLE PRECISION DUMMYA(36)                                               G0064880
ISN        24         DOUBLE PRECISION CFX(4),CFY(4)                                            G0064890
ISN        25         DOUBLE PRECISION JACOBN                                                   G0064900
ISN        26         DOUBLE PRECISION FTMXCN(10,36),FTMYCN(10,36)                              G0064910
ISN        27         DOUBLE PRECISION GVCXH(55),GVCXHO(NGRPMX)                                 G0064920
ISN        28         DOUBLE PRECISION GVCXV(55),GVCXVO(NGRPMX)                                 G0064930
ISN        29         DOUBLE PRECISION GVCYH(55),GVCYHO(NGRPMX)                                 G0064940
ISN        30         DOUBLE PRECISION GVCYV(55),GVCYVO(NGRPMX)                                 G0064950
ISN        31         DOUBLE PRECISION DXCFL(10),DXCFLO(NBALNS)                                 G0064960
ISN        32         DOUBLE PRECISION DYCFL(10),DYCFLO(NBALNS)                                 G0064970
ISN        33         DOUBLE PRECISION SPLIT(8,11),SPLITO(NDIRMX,NWELMX)                        G0064980
ISN        34         DOUBLE PRECISION SRCETM(10,8,11),SRCETO(NBALNS,NDIRMX,NWELMX)             G0064990
                  C                                                                             G0065000
ISN        35         LOGICAL COORTR,TRACKF,OVTAKE,DATAFR,RESTRT                                G0065010
ISN        36         DOUBLE PRECISION LAMBDA                                                   G0065020
ISN        37         LOGICAL SWIT1,SWIT2,SWIT3,SWIT4,SWIT5,SWIT6,SWIT7,SWIT8                   G0065030
ISN        38         INTEGER FPJX,FPJY                                                         G0065040
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                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
ISN       39          LOGICAL LFRNT                                                          GD0065050
ISN       40          LOGICAL BLSPEC                                                         GD0065060
ISN       41          INTEGER EDSIGN                                                         GD0065070
ISN       42          CHARACTER*4 CYLN,SPHR,CSYSTM                                           GD0065080
ISN       43          LOGICAL L2SYMM,LCIRCL                                                  GD0065090
ISN       44          CHARACTER*6 TRANSP,MATCHC,BOTH,NEITHR,EQTYPE                           GD0065100
                  C                                                                        GD0065110
ISN       45          COMMON/PRMBLK/SMC,SOIRR,SGIRR,SGPDUM,SWPDUM,KRGDUM,KROG,KROM,          GD0065120
                 1                KRMDUM,KRODUM,KRGSGD,KROGSG,KROMSM,KRMSMD,KROSGD,       GD0065130
                 2                KROSMD,PCMDUM,PCVDUM,                                   GD0065140
                 3                LCTN,IERR,IWRONG                                        GD0065150
ISN       46          COMMON/GRIPRO/DT,DXFRNT,DISXM,DX(57),DISTX(58),NFRONT,NBLOKS,          GD0065160
                 1             NG,NJAY,COORTR,TRACKF,OVTAKE,DATAFR,RESTRT                 GD0065170
ISN       47          COMMON/STATEV/SWP(55),SGP(55),SOP(55),T(55),P(55),                     GD0065180
                 1             XMOLE(3,55),XO(55),XSOL(55),XN(55)                         GD0065190
ISN       48          COMMON/FLUPRO/DWP(55),DOP(55),DGP(55),UWP(55),UOP(55),UGP(55),         GD0065200
                 1             CWP(55),COP(55),CGP(55),KO(55),KSOL(55),LAMBDA(55),        GD0065210
                 2             DENSOL(55),DENSOM(55),DENSOS(55),                          GD0065220
                 3             DFSPCM(55),DFSPCO(55),DFSPCV(55),GASCON                    GD0065230
ISN       49          COMMON/CPUTIM/CPUOLD,DELCPU(18)                                        GD0065240
ISN       50          COMMON/SWIT  /SWIT1,SWIT2,SWIT3,SWIT4,SWIT5,SWIT6,SWIT7,SWIT8          GD0065250
ISN       51          COMMON/BASICS/ZERO,HALF,ONE,TWO                                        GD0065260
ISN       52          COMMON/IBASCS/NULL                                                     GD0065270
ISN       53          COMMON/DIMENS/NDIMNS,NX,NY,NOS,NRS,NRFM,NRFP                           GD0065280
ISN       54          COMMON/FRONT1/NFPTOT,FPJX(16),FPJY(16)                                 GD0065290
ISN       55          COMMON/FRONT3/FPDIST(16),FPDISX(16),FPDISY(16),FPDSNM(16)              GD0065300
ISN       56          COMMON/TABLS1/NBLKS,NGRPS,JGRPOG(50),JAGPOF(9,16),                     GD0065310
                 1                JBLK(55),JFPT(55)                                       GD0065320
ISN       57          COMMON/TABL1A/LFRNT(55)                                                GD0065330
ISN       58          COMMON/BVOLFL/BVFLOW(28),FLFR(150)                                     GD0065340
ISN       59          COMMON/GRAVTY/GX,GY,DENMSM(55),DENMSO(55),DENMSV(55),GRAVP(55)         GD0065350
ISN       60          COMMON/CBCORX/BLCORX(8,50)                                             GD0065360
ISN       61          COMMON/CBCORY/BLCORY(8,50)                                             GD0065370
ISN       62          COMMON/CBSPEC/BLSPEC(8,50)                                             GD0065380
ISN       63          COMMON/CBAREA/BLAREA(50),OBAREA(50)                                    GD0065390
ISN       64          COMMON/GPXY  /GPX(55),GPY(55)                                          GD0065400
ISN       65          COMMON/EDSMAL/NDIRS,NEDGES,EDSIGN(8)                                   GD0065410
ISN       66          COMMON/EDTOE1/JBLKOE(4,150)                                            GD0065420
ISN       67          COMMON/EDTOG /JEDGOG(8,55)                                             GD0065430
ISN       68          COMMON/EDTOF /JEDGOF(2,16),JPEDHO(16),JPEDVE(16)                       GD0065440
ISN       69          COMMON/EDLOCT/EDSTAX(150),EDSTAY(150),EDFINX(150),EDFINY(150)          GD0065450
ISN       70          COMMON/SCALES/SCALEP,SCALEH,SCALEV,SCALVF                              GD0065460
ISN       71          COMMON/ADJACN/IFORML,JUPGRP(16),JADJAC(4,55)                           GD0065470
ISN       72          COMMON/IBCONS/IHEQN,IHBAL,IVEQN,IVBAL                                  GD0065480
ISN       73          COMMON/CORSYS/CYLN,SPHR,CSYSTM                                         GD0065490
ISN       74          COMMON/LOGSYM/L2SYMM,LCIRCL                                            GD0065500
ISN       75          COMMON/EQNTYP/TRANSP,MATCHC,BOTH,NEITHR,EQTYPE(10,3)                   GD0065510
ISN       76          COMMON/EQNTCD/IEQCOD(10,55)                                            GD0065520
ISN       77          COMMON/IJTBIJ/IOFGRP(55),JOFGRP(55),JGRPIJ(36,24)                      GD0065530
ISN       78          COMMON/TABLS2/NRLGS,JGRPOF(16),JRLG(55),JGRPOR(54),                    GD0065540
                 1                JGPTNR(55),JTYFRM(55),JTYRFL(55),JRFLIN(55)             GD0065550
ISN       79          COMMON/GLINEC/GLINEO(36),GLINER(24)                                    GD0065560
ISN       80          COMMON/TGRID /SINTHT(36),COSTHT(36),SINTHA(36),COSTHA(36),             GD0065570
                 1                SINIPA(36),COSIPA(36),SINIPA(36),COSIPA(36),           GD0065580
ISN       81          COMMON/DGRID /DTHTAM(36),DTHTAP(36),DOPHHH(36),DTHETA(36),             GD0065590
                 1                DFOWTM(36),DFOWTP(36),                                  GD0065600
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                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
                 2                DRPHHH(24),DRADM1(24),DRADP1(24)                        GD0065610
ISN       82          COMMON/FRNTCF/DCENDS,CENDIS,FRNDIS(36),DFRDTH(36),FRFRTH(36),          GD0065620
                 1                VFDOTM(36),XIRING(36),YIRING(36)                        GD0065630
ISN       83          COMMON/OFRNCF/OFRNDS(36)                                               GD0065640
ISN       84          COMMON/WELLJ1/NWELLS,IENTWO(11),IENTHR(11),JGNEAR(11),                 GD0065650
                 1                JWELOG(55)                                              GD0065660
ISN       85          COMMON/WELLJ2/JGPSC(8,11)                                              GD0065670
ISN       86          COMMON/WELLLG/LWELLM(11),LWELL(55)                                     GD0065680
                  C                                                                       GD0065690
                  C  PAGE 1A                                                              GD0065700
                  C  INPUT SCALARS: ZERO, ONE, NGRPS                                      GD0065710
                  C  INPUT  ARRAYS:                                                       GD0065720
                  C  OUTPUT AND LOCAL ARRAYS: CONCT,ACCUM,GRPLIS                          GD0065730
                  C                                                                       GD0065740
                  C  PAGE 1B                                                              GD0065750
                  C  INPUT SCALARS: NGRPS OR NGRPSP?, NEDGES                              GD0065760
                  C  INPUT  ARRAYS:                                                       GD0065770
                  C  OUTPUT AND LOCAL ARRAYS: OCONCT,CONCTO,FLOW,FLOWO,EDGLIS            GD0065780
                  C                                                                       GD0065790
                  C  PAGE 2A                                                              GD0065800
                  C  INPUT SCALARS: NULL                                                  GD0065810
                  C  INPUT  ARRAYS: LFRNT,JFPT,JBLK,JEDGOG                               GD0065820
                  C  OUTPUT AND LOCAL ARRAYS: DACUM,VFDOTN,BLAREA,OBLAREA(SIC),EDSIGN    GD0065830
                  C                                                                       GD0065840
                  C  PAGE 2B                                                              GD0065850
                  C  INPUT SCALARS: MUS,NMCS,NFPTOT,NVARS,NCONXS                          GD0065860
                  C  INPUT  ARRAYS: LFRNT,JFPT,JBLK                                       GD0065870
                  C  OUTPUT AND LOCAL ARRAYS: FF2D,FF02D,U1D,COEFFS,LCONV                 GD0065880
                  C  OUTPUT SCALAR: REPEAT                                                GD0065890
                  C                                                                       GD0065900
ISN       87  47990 FORMAT(' AT CHECKPOINT ',I2,', THE TOTAL TIME IS ',F8.4,              GD0065910
                 1    SEC. WITH ',F7.4,' SEC. SINCE THE PREVIOUS CHECKPOINT.')          GD0065920
                  C                                                                       GD0065930
ISN       88          IF (.NOT.SWIT3) THEN                                                GD0065940
ISN       89             ICHECK=3                                                         GD0065950
ISN       90             CPUNEW=UTTIMR(1)                                                 GD0065960
ISN       91             CPUINC=CPUNEW-CPUOLD                                             GD0065970
ISN       92             DELCPU(ICHECK)=CPUINC                                            GD0065980
ISN       93             CPUOLD=CPUNEW                                                    GD0065990
ISN       94             WRITE(6,47990)ICHECK,CPUNEW,CPUINC                               GD0066000
ISN       95             DELCPU(ICHECK)=CPUINC                                            GD0066010
ISN       96          END IF                                                              GD0066020
                  C                                                                       GD0066030
ISN       97          CALL PROPTY(1,NGRPS,61,0)                                           GD0066040
                  C     I.E. CALL SUBROUTINE PROPTY(ISTART,IFINIS,LCTNPH,IJOB)            GD0066050
ISN       98          IF (IERR.NE.0) RETURN                                               GD0066060
                  C                                                                       GD0066070
                  C                                                                       GD0066080
ISN      100          CALL CTFCFS(L2SYMM,1,NOS,NOS,NRS,NOMAX,NGRPMX,                      GD0066090
                 1            DT,DCENDS,CENDIS,GX,GY,                                    GD0066100
                 2            FRNDIS,OFRNDS,DFOWTM,DFOWTP,                               GD0066110
                 3            DFRDTH,FRFRTH,VFDOTN,XIRING,YIRING,                        GD0066120
                 4            GRAVP)                                                     GD0066130
                  C        I.E. CALL CTFCFS(L2SYMM,JOSTA,JOFIN,NOS,NRS,NOMAX,NGRPMX,      GD0066140
                  C                         DT,DCENDS,CENDIS,GX,GY,                     GD0066150
                  C                         FRNDIS,OFRNDS,DFOWTM,DFOWTP,                GD0066160
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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
                C                           DFRDTH,FRFRTH,VFDOTH,XIRING,YIRING,                 G0066170
                CC                          GRAVP)                                              G0066180
                C                                                                               G0066190
ISN      101          CALL EQCDCL(.FALSE.,.TRUE.,NCOMPS,NBALNS,                                 G0066200
                     1            NOMAX,NGRPMX,NEDGMX,                                         G0066210
                     2            VFDOTH,CONCL,CONCV,FLTHTO,                                   G0066220
                     3            IEQCOD)                                                      G0066230
                C       I.E. CALL EQCDCL(LEINIT,LOUTP,NCOMPS,NBALNS,                            G0066240
                CC                          NOMAX,NGRPMX,NEDGMX,                                G0066250
                CC                          VFDOTH,CONCL,CONCV,FLTHTO,                          G0066260
                CC                          IEQCOD)                                             G0066270
                C                                                                               G0066280
ISN      102          NCALCS=NGRPS                                                              G0066290
ISN      103          DO 140 JCALC=1,NCALCS                                                     G0066300
ISN      104            GRPLIS(JCALC)=JCALC                                                     G0066310
ISN      105      140 CONTINUE                                                                  G0066320
                C                                                                               G0066330
ISN      106          CALL ACUMCL(.TRUE.,.FALSE.,.TRUE.,                                        G0066340
                     1            NFPTMX,NGRPMX,NATRMX,NCOMPS,NBALNS,                          G0066350
                     2            NCALCS,GRPLIS,ENHCF,VOLCF,                                   G0066360
                     3            CONCL,CONCV,SCAREA,ACCUM,ACUMF)                              G0066370
                C       I.E. CALL ACUMCL(ALGRPS,INITLZ,TEST,                                    G0066380
                CC                          NFPTMX,NGRPMX,NATRMX,NCOMPS,NBALNS,                 G0066390
                CC                          NCALCS,GRPLIS,ENHCF,VOLCF,                          G0066400
                CC                          CONCL,CONCV,SCAREA,ACCUM,ACUMF)                     G0066410
                C                                                                               G0066420
ISN      107          DO 170 JGRPJ=1,NGRPS                                                      G0066430
ISN      108            DO 160 IBALN=1,NBALNS                                                   G0066440
ISN      109              ACCUMO(IBALN,JGRPJ)=ACCUM(IBALN,JGRPJ)                                G0066450
ISN      110      160     CONTINUE                                                              G0066460
ISN      111      170 CONTINUE                                                                  G0066470
                C                                                                               G0066480
                CC                                                                              G0066490
ISN      112          CALL GVCFCL(.TRUE.,NGRPMX,NCALCS,GRPLIS,                                  G0066500
                     1            GVCXH,GVCXV,GVCYH,GVCYV)                                     G0066510
                C       I.E. CALL GVCFCL(ALGRPS,NGRPMX,NCALCS,GRPLIS,                           G0066520
                CC                          GVCXH,GVCXV,GVCYH,GVCYV)                            G0066530
                CC                                                                              G0066540
ISN      113          DO 190 JGRPJ=2,NGRPS                                                      G0066550
ISN      114            GVCXHO(JGRPJ)=GVCXH(JGRPJ)                                              G0066560
ISN      115            GVCXVO(JGRPJ)=GVCXV(JGRPJ)                                              G0066570
ISN      116            GVCYHO(JGRPJ)=GVCYH(JGRPJ)                                              G0066580
ISN      117            GVCYVO(JGRPJ)=GVCYV(JGRPJ)                                              G0066590
ISN      118      190 CONTINUE                                                                  G0066600
                C                                                                               G0066610
                CC                                                                              G0066620
ISN      119          NCALCS=NEDGES                                                             G0066630
ISN      120          DO 240 JCALC=1,NCALCS                                                     G0066640
ISN      121            EDGLIS(JCALC)=JCALC                                                     G0066650
ISN      122      240 CONTINUE                                                                  G0066660
                C                                                                               G0066670
ISN      123          CALL FLTMCL(.TRUE.,TEST,NEDGMX,NOMAX,NCOMPS,NBALNS,                       G0066680
                     1            NCALCS,EDGLIS,                                               G0066690
                     2            FLTMXA,FLTMYA,FLTMTA)                                        G0066700
                C       I.E. CALL FLTMCL(ALEDGS,TEST,NEDGMX,NOMAX,NCOMPS,NBALNS,                G0066710
                CC                          NCALCS,EDGLIS,                                      G0066720
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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
                C                           FLTMXA,FLTMYA,FLTMTA)                               G0066730
                CC                                                                              G0066740
ISN      124          DO 290 JEDGEJ=1,NEDGES                                                    G0066750
ISN      125            DO 280 IBALN=1,NBALNS                                                   G0066760
ISN      126              FLTMXO(IBALN,JEDGEJ)=FLTMXA(IBALN,JEDGEJ)                             G0066770
ISN      127              FLTMYO(IBALN,JEDGEJ)=FLTMYA(IBALN,JEDGEJ)                             G0066780
ISN      128              FLTMTO(IBALN,JEDGEJ)=FLTMTA(IBALN,JEDGEJ)                             G0066790
ISN      129      280     CONTINUE                                                              G0066800
ISN      130      290 CONTINUE                                                                  G0066810
                C                                                                               G0066820
                CC      COMBINE ACCUMS AND FLTMS TO CALCULATE FF2DS.                            G0066830
                CC      THE PLAN IS TO FIRST CALCULATE FLOSUM, AND THEN COMBINE                 G0066840
                CC      FLOSUM WITH ACCUM TO OBTAIN A PRELIMINARY ESTIMATE OF FF2D.             G0066850
                CC                                                                              G0066860
ISN      131          DO 390 JGRPJ=1,NGRPS                                                      G0066870
ISN      132            IF (JGRPJ.EQ.1) THEN                                                    G0066880
                CC            THE DISCRETE FOURIER TRANSFORM LOOKS ELEGANT.                     G0066890
                CC            HOWEVER, BOTH R AND DTHETA VARY.                                  G0066900
                CC            THEREFORE, WE USE LEAST SQUARES.                                  G0066910
ISN      133            DO 308 I=1,NOS                                                          G0066920
ISN      134              JEDGEJ=I                                                              G0066930
ISN      135              DO 306 IBALN=1,NBALNS                                                 G0066940
ISN      136                FTMXCN(IBALN,I)=FLTMXA(IBALN,JEDGEJ)                                G0066950
ISN      137                FTMYCN(IBALN,I)=FLTMYA(IBALN,JEDGEJ)                                G0066960
ISN      138      306       CONTINUE                                                            G0066970
ISN      139      308     CONTINUE                                                              G0066980
                C                                                                               G0066990
ISN      140            CALL HLLSSQ(NOMAX,NOS,NBALNS,                                         G0067000
                     1                      XIRING,YIRING,FTMXCN,FTMYCN,                       G0067010
                     2                      DXCFL,DYCFL)                                       G0067020
                C       I.E. CALL HLLSSQ(NOMAX,NOS,NBALNS,                                      G0067030
                CC                                XIRING,YIRING,FTMXCN,FTMYCN,                  G0067040
                CC                                DXCFL,DYCFL)                                  G0067050
                CC            THE SIGNS OF DXCFL AND DYCFL MUST BE CHECKED CAREFULLY.           G0067060
                C                                                                               G0067070
ISN      141            DO 320 IBALN=1,NBALNS                                                   G0067080
ISN      142              DXCFLO(IBALN)=DXCFL(IBALN)                                            G0067090
ISN      143              DYCFLO(IBALN)=DYCFL(IBALN)                                            G0067100
ISN      144              FLOTRM(IBALN)=DXCFL(IBALN)+DYCFL(IBALN)                               G0067110
ISN      145      320     CONTINUE                                                              G0067120
ISN      146            END IF                                                                  G0067130
                C                                                                               G0067140
                CC-------------------------------------------------------------------------    G0067150
                CC      THE FOLLOWING SECTION WAS DELETED.                                      G0067160
                CC      THE ABOVE SECTION WAS DELETED.                                          G0067170
                CC-------------------------------------------------------------------------    G0067180
                C                                                                               G0067190
ISN      147            IF (JGRPJ.GT.1) THEN                                                    G0067200
ISN      148              JTYFRJ=JTYFRM(JGRPJ)                                                  G0067210
ISN      149              DO 342 IBALN=1,NBALNS                                                 G0067220
ISN      150                FLOSUM(IBALN)=ZERO                                                  G0067230
ISN      151      342     CONTINUE                                                              G0067240
                C         I=IOFGRP(JGRPJ)                                                     G0067250
                CC        J=JOFGRP(JGRPJ)                                                     G0067260
                CC                                                                            G0067270
                                                                                              G0067280
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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
                C
                C            IF (CSYSTM.EQ.CYLN) THEN                                          G0067290
                C               JACOBN=GLINER(J)*FRNDIS(I)**2                                  G0067300
                C                  SINCE JGRPJ > 1, J CANNOT EQUAL 1,                          G0067310
                C                  AND JACOBN CANNOT EQUAL ZERO.                               G0067320
                C               DXDO=GLINER(J)*(DFRDTH(I)*COSTHT(I)-FRNDIS(I)*SINTHT(I))      G0067330
                C               DYDO=GLINER(J)*(DFRDTH(I)*SINTHT(I)+FRNDIS(I)*SINTHT(I))      G0067340
                C               DXDR=FRNDIS(I)*COSTHT(I)                                      G0067350
                C               DYDR=FRNDIS(I)*SINTHT(I)                                      G0067360
                C               CXHORZ=-DXDO/(-JACOBN*DRPHHH(J))                              G0067370
                C               CYHORZ= DYDO/(-JACOBN*DRPHHH(J))                              G0067380
                C               CXVERT= DXDR/(-JACOBN*DOPHHH(I))                              G0067390
                C               CYVERT=-DYDR/(-JACOBN*DOPHHH(I))                              G0067400
                C                  THESE SIGNS MUST BE CHECKED VERY CAREFULLY.                 G0067410
                C             END IF                                                           G0067420
                C                                                                              G0067430
                C            IF (CSYSTM.EQ.SPHR) THEN                                          G0067440
                C               JACOBN=GLINER(J)*FRNDIS(I)**2                                  G0067450
                C                  SINCE JGRPJ > 1, J CANNOT EQUAL 1,                          G0067460
                C                  AND JACOBN CANNOT EQUAL ZERO.                               G0067470
                C               DXDO=GLINER(J)*(DFRDTH(I)*COSTHT(I)-FRNDIS(I)*SINTHT(I))      G0067480
                C               DYDO=GLINER(J)*(DFRDTH(I)*SINTHT(I)+FRNDIS(I)*SINTHT(I))      G0067490
                C               DXDR=FRNDIS(I)*COSTHT(I)                                      G0067500
                C               DYDR=FRNDIS(I)*SINTHT(I)                                      G0067510
                C               CXHORZ=-DXDO/(-JACOBN*DRPHHH(J))                              G0067520
                C               CYHORZ= DYDO/(-JACOBN*DRPHHH(J))                              G0067530
                C               CXVERT= DXDR/(-JACOBN*DOPHHH(I))                              G0067540
                C               CYVERT=-DYDR/(-JACOBN*DOPHHH(I))                              G0067550
                C                  THESE SIGNS MUST BE CHECKED VERY CAREFULLY.                 G0067560
                C             END IF                                                           G0067570
                C                                                                              G0067580
ISN     152             CFX(1)=GVCXH(JGRPJ)                                                    G0067590
ISN     153             CFX(2)=GVCXV(JGRPJ)                                                    G0067600
ISN     154             CFX(3)=GVCXH(JGRPJ)                                                    G0067610
ISN     155             CFX(4)=GVCXV(JGRPJ)                                                    G0067620
ISN     156             CFY(1)=GVCYH(JGRPJ)                                                    G0067630
ISN     157             CFY(2)=GVCYV(JGRPJ)                                                    G0067640
ISN     158             CFY(3)=GVCYH(JGRPJ)                                                    G0067650
ISN     159             CFY(4)=GVCYV(JGRPJ)                                                    G0067660
                C               ADD UP THE FLOW TERMS FOR THE TRANSPORT EQUATIONS.             G0067670
                C               BUT NOT YET FOR THE MATCHING CONDITIONS.                       G0067680
ISN     160             DO 350 JDIR=1,NDIRS                                                    G0067690
ISN     161               JEDGEJ=JEDGOG(JDIR,JGRPJ)                                            G0067700
ISN     162               IF (JEDGEJ.GT.NULL) THEN                                             G0067710
                C                 EDSIGN IS INITIALIZED IN THE MAIN PROGRAM.                   G0067720
ISN     163                 IF (EDSIGN(JDIR+JDIR).GT.0) THEN                                   G0067730
ISN     164                   DO 344 IBALN=1,NBALNS                                            G0067740
ISN     165                     EQCD=EQTYPE(IBALN,IEQCOD(IBALN,JGRPJ))                         G0067750
ISN     166                     IF (EQCD.EQ.TRANSP.OR.EQCD.EQ.BOTH)                            G0067760
                     1                FLOSUM(IBALN) = ( FLOSUM(IBALN)                         G0067770
                     2                                + CFX(JDIR)*FLTMXA(IBALN,JEDGEJ)        G0067780
                     3                                + CFY(JDIR)*FLTMYA(IBALN,JEDGEJ) )      G0067790
                C                       FLTMXA(IBALN,JEDGEJ) AND FLTMYA(IBALN,JEDGEJ)       G0067800
                C                       DO NOT INCLUDE THE DT FACTOR.                          G0067810
ISN     168     344                   CONTINUE                                                 G0067820
ISN     169                         ELSE                                                       G0067830
ISN     170                           DO 346 IBALN=1,NBALNS                                    G0067840
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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
ISN     171                           EQCD=EQTYPE(IBALN,IEQCOD(IBALN,JGRPJ))                 G0067850
ISN     172                           IF (EQCD.EQ.TRANSP.OR.EQCD.EQ.BOTH)                    G0067860
                     1                FLOSUM(IBALN) = ( FLOSUM(IBALN)                         G0067870
                     2                                + CFX(JDIR)*FLTMXA(IBALN,JEDGEJ)        G0067880
                     3                                + CFY(JDIR)*FLTMYA(IBALN,JEDGEJ) )      G0067890
                C                       FLTMXA(IBALN,JEDGEJ) AND FLTMYA(IBALN,JEDGEJ)       G0067900
                C                       DO NOT INCLUDE THE DT FACTOR.                          G0067910
ISN     174     344                   CONTINUE                                                 G0067920
ISN     175                           END IF                                                   G0067930
                C                                                                              G0067940
ISN     176                       END IF                                                       G0067950
ISN     177     350             CONTINUE                                                       G0067960
                C               NOW ADD UP THE FLOW TERMS FOR THE MATCHING CONDITIONS.         G0067970
ISN     178             IF (LFRNT(JGRPJ)) THEN                                                 G0067980
ISN     179               JFPTJ=JFPT(JGRPJ)                                                    G0067990
ISN     180               JEDGE1=JEDGOF(1,JFPTJ)                                               G0068000
ISN     181               JEDGE2=JEDGOF(2,JFPTJ)                                               G0068010
ISN     182               DO 360 IBALN=1,NBALNS                                                G0068020
ISN     183                 EQCD=EQTYPE(IBALN,IEQCOD(IBALN,JGRPJ))                             G0068030
ISN     184                 IF (EQCD.EQ.MATCHC.OR.EQCD.EQ.BOTH)                                G0068040
                     1          FLOSUM(IBALN) = ( FLOSUM(IBALN)                               G0068050
                     2                          -FLTMTA(IBALN,JEDGE1)                         G0068060
                     3                          +FLTMTA(IBALN,JEDGE2) )                       G0068070
                C                  THESE SIGNS SHOULD BE CHECKED CAREFULLY.                    G0068080
ISN     186     360           CONTINUE                                                         G0068090
ISN     187                 END IF                                                             G0068100
                C                                                                              G0068110
ISN     188               DO 362 IBALN=1,NBALNS                                                G0068120
ISN     189                 FLOTRM(IBALN)=FLOSUM(IBALN)                                        G0068130
ISN     190     362         CONTINUE                                                           G0068140
                C                                                                              G0068150
ISN     191             END IF                                                                 G0068160
                C                                                                              G0068170
ISN     192             DO 370 JEQN=1,NVARS                                                    G0068180
ISN     193               ILIQ=JEQN                                                            G0068190
ISN     194               IVAP=JEQN+NVARS                                                      G0068200
                C                FF2D(IMEQN,*) WILL BE OVERWRITTEN IF SMIT4 IS FALSE.          G0068210
                C                FF2D(IVEQN,*) WILL BE OVERWRITTEN IF SMIT1 IS FALSE.          G0068220
ISN     195               FF2D(JEQN,JGRPJ)=ACCUM(ILIQ,JGRPJ)+DT*FLOTRM(ILIQ)                   G0068230
                     1                    +ACCUM(IVAP,JGRPJ)+DT*FLOTRM(IVAP)                   G0068240
ISN     196     370     CONTINUE                                                               G0068250
ISN     197     390   CONTINUE                                                                 G0068260
                C                                                                              G0068270
                C         SUBTRACT THE SOURCE TERMS FROM FF2D.                                 G0068280
                C                                                                              G0068290
                C                                                                              G0068300
ISN     198           CALL SRCECL(.TRUE.,.TRUE.,TEST,                                          G0068310
                     1            NWELMX,NDIRMX,NBALNS,                                        G0068320
                     2            SPLIT,SRCETH)                                                G0068330
                C          I.E. CALL SRCECL(LCSPLT,LCSCTH,TEST,                                G0068340
                C                           NWELMX,NDIRMX,NBALNS,                              G0068350
                C                           SPLIT,SRCETH)                                      G0068360
                C                                                                              G0068370
ISN     199             DO 440 IWELL=1,NWELLS                                                  G0068380
ISN     200               DO 435 IDIR=1,NDIRS                                                  G0068390
ISN     201                 DO 430 IBALN=1,NBALNS                                              G0068400
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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
ISN      202                SRCETO(IBALN,IDIR,IMELL)=SRCETM(IBALN,IDIR,IMELL)                    G0068410
ISN      203      430       CONTINUE                                                             G0068420
ISN      204                SPLITO(IDIR,IMELL)=SPLIT(IDIR,IMELL)                                 G0068430
ISN      205      435    CONTINUE                                                                G0068440
ISN      206      440 CONTINUE                                                                   G0068450
                C                                                                               G0068460
ISN      207         DO 490 IMELL=1,NMELLS                                                      G0068470
ISN      208            DO 480 IDIR=1,NDIRS                                                     G0068480
ISN      209               JGRPJ=JGPSC(IDIR,IMELL)                                              G0068490
ISN      210               DO 470 JEQN=1,NVARS                                                  G0068500
ISN      211                  ILIQ=JEQN                                                         G0068510
ISN      212                  IVAP=JEQN+NVARS                                                   G0068520
ISN      213                  FF2D(JEQN,JGRPJ) = ( FF2D(JEQN,JGRPJ)                             G0068530
                     1                                -DT*SRCETM(ILIQ,IDIR,IMELL)              G0068540
                     2                                -DT*SRCETM(IVAP,IDIR,IMELL) )            G0068550
ISN      214      470         CONTINUE                                                          G0068560
ISN      215      480      CONTINUE                                                             G0068570
ISN      216      490   CONTINUE                                                                G0068580
                C                                                                               G0068590
                CCCC     STORE A COPY OF FF2D IN FF2DO, IN CASE FF2DO IS NEEDED FOR             G0068600
                CCCC     THE NUMERICAL CALCULATION OF THE NONLINEAR-SYSTEM-JACOBIAN.            G0068610
                C                                                                               G0068620
ISN      217         DO 520 JGRPJ=1,NGRPS                                                       G0068630
ISN      218            DO 510 IVAR=1,NVARS                                                     G0068640
ISN      219               FF2DO(IVAR,JGRPJ)=FF2D(IVAR,JGRPJ)                                   G0068650
ISN      220      510      CONTINUE                                                             G0068660
ISN      221      520   CONTINUE                                                                G0068670
                C                                                                               G0068680
                CCCCC    THE CALCULATION OF COEFFS SHOULD BE WITHIN LINES 443/467.              G0068690
                CCCCC    NOW CALCULATE COEFFS.                                                  G0068700
                C                                                                               G0068710
                C                                                                               G0068720
ISN      222         CALL ALAJST(.TRUE.,ONE,U1D,                                                G0068730
                     1           TEST  ,NGRPMX,NFPTMX,NWELMX,NBNDMX,NBLKMX,                     G0068740
                     2           NDIRMX,NEDGMX,NCONMX,NUMAX ,NATRMX,NOMAX ,                     G0068750
                     3           NMCS  ,NCOMPS,NVARS ,NBALNS,                                   G0068760
                     4           ACCUMO,FLTMXO,FLTMYO,FLTMTO,                                   G0068770
                     5           ENMCFO,VOLCFO,FLORMO,ACUMFO,FLOMO ,                            G0068780
                     6           GVCXMO,GVCXVO,GVCYMO,GVCYVO,                                   G0068790
                     7           DXCFLO,DYCFLO,SPLITO,SRCETO,                                   G0068800
                     8           FF2DO ,COEFFS,LCONV ,REPEAT)                                   G0068810
                C        I.E. CALL ALAJST(JCCALC,FDAMP ,U1D,                                    G0068820
                CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCG0068830
                CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCG0068840
                CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCG0068850
                CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCG0068860
                CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCG0068870
                CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCG0068880
                CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCG0068890
                CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCG0068900
                C                                                                               G0068910
ISN      223         RETURN                                                                     G0068920
ISN      224         END                                                                        G0068930
*STATISTICS*   SOURCE STATEMENTS = 220, PROGRAM SIZE = 95896 BYTES, PROGRAM NAME = CTEQNS    PAGE:  136.
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*STATISTICS*    NO DIAGNOSTICS GENERATED.
**CTEQNS** END OF COMPILATION 28 ******
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OPTIONS IN EFFECT:  NOLIST NOMAP NOXREF NOGOSTMT NODECK   SOURCE   TERM NOOBJECT FIXED  NOTEST   TRMFLG   SRCFLG
                    NOSYM NORENT   SDUMP AUTODBL(NONE)   NOSXM    IL
                      OPT(0) LANGLVL(77) NOFIPS   FLAG(I)   NAME(MAIN  )  LINECOUNT(60)      CHARLEN(500)

                 *....*...1.........2.........3.........4.........5.........6.........7.*... ...8

                 C.ALSCAL                                                                          G0068940
                 C                                                                                 G0068950
                 C  S00.  SCALE COEFFS AND FF2D SO ALL DIAGONAL ELEMENTS EQUAL ONE.                G0068960
                 C                                                                                 G0068970
ISN         1          SUBROUTINE ALSCAL(JCSM,NGRPMX,NCONMX,NVARS,                                G0068980
                     1                    DSCALE,FF2D,COEFFS)                                      G0068990
ISN         2          IMPLICIT DOUBLE PRECISION (A-H,K,O-Z)                                      G0069000
                 C                                                                                 G0069010
ISN         3          LOGICAL JCSM                                                               G0069020
ISN         4          DOUBLE PRECISION DSCALE(NVARS,NGRPMX),FF2D(NVARS,NGRPMX)                   G0069030
ISN         5          DOUBLE PRECISION COEFFS(NVARS,NVARS,NCONMX)                                G0069040
                 C                                                                                 G0069050
                 C                                                                                 G0069060
ISN         6          COMMON/BASICS/ZERO,HALF,ONE,TWO                                            G0069070
ISN         7          COMMON/TABLS1/NBLKS,NGRPS,JGRPOG(50),JAGPOF(9,16),                         G0069080
                     1                JBLK(55),JFPT(55)                                          G0069090
ISN         8          COMMON/YALC01/MUS,MCONXS,JBDIAG,J1CONX(55),NNEIBS(55),                     G0069100
                     1                JGRPOC(715),JNEIBR(715)                                    G0069110
ISN         9          COMMON/YALC02/MBANMX,JCONX(73,55)                                          G0069120
                 C                                                                                 G0069130
ISN        10          IF (.NOT.JCSM) THEN                                                        G0069140
ISN        11             DO 150 JGRPJ=1,NGRPS                                                    G0069150
ISN        12                DO 140 JEQN=1,NVARS                                                  G0069160
ISN        13                   DSCALE(JEQN,JGRPJ)=ZERO                                           G0069170
ISN        14   140          CONTINUE                                                            G0069180
ISN        15   150       CONTINUE                                                               G0069190
ISN        16             DO 180 JCONXJ=1,MCONXS                                                G0069200
ISN        17                JGP=JNEIBR(JCONXJ)                                                 G0069210
ISN        18                DO 170 JEQN=1,NVARS                                                G0069220
ISN        19                   DSCALJ=DSCALE(JEQN,JGP)                                         G0069230
ISN        20                   DO 160 JVAR=1,NVARS                                             G0069240
ISN        21                      IF (DABS(DSCALJ).LT.DABS(COEFFS(JEQN,JVAR,JCONXJ)))          G0069250
                     1                DSCALJ=COEFFS(JEQN,JVAR,JCONXJ)                           G0069260
                 C                       TO PRESERVE THE SIGN.                                   G0069270
ISN        23   160                 CONTINUE                                                    G0069280
ISN        24                       DSCALE(JEQN,JGP)=DSCALJ                                     G0069290
ISN        25   170             CONTINUE                                                        G0069300
ISN        26   180          CONTINUE                                                           G0069310
                 C            DO 220 JGRPJ=1,NGRPS  WAS DELETED.                                G0069320
                 C               JCONXJ=JCONX(JBDIAG,JGRPJ)  WAS DELETED.                       G0069330
                 C               DO 210 JEQN=1,NVARS  WAS DELETED.                              G0069340
                 C                  DSCALJ=DABS(COEFFS(JEQN,JEQN,JCONXJ))  WAS DELETED.         G0069350
                 C                  IF (DSCALJ.LT.1.0D-7) DSCALJ=ONE  WAS DELETED.              G0069360
                 C                  DSCALE(JEQN,JGRPJ)=DSCALJ  WAS DELETED.                     G0069370
                 C  210          CONTINUE  WAS DELETED.                                         G0069380
                 C  220       CONTINUE  WAS DELETED.                                            G0069390
                 C                                                                              G0069400
                 C            THE TWO JCONXJ LOOPS CANNOT BE COMBINED, BECAUSE THE              G0069410
                 C            FIRST LOOP PERFORMS A MAXIMIZATION.                               G0069420
ISN        27             DO 280 JCONXJ=1,NCONXS                                               G0069430
ISN        28                JGP=JNEIBR(JCONXJ)                                                G0069440
ISN        29                DO 270 JEQN=1,NVARS                                               G0069450
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                 *....*...1.........2.........3.........4.........5.........6.........7.*.......8

ISN        30                   DO 260 JVAR=1,NVARS                                           G0069460
ISN        31                      COEFFS(JEQN,JVAR,JCONXJ)=( COEFFS(JEQN,JVAR,JCONXJ)        G0069470
                     1                                        /DSCALE(JEQN,JGP) )              G0069480
ISN        32   260                CONTINUE                                                    G0069490
ISN        33   270             CONTINUE                                                       G0069500
ISN        34   280          CONTINUE                                                          G0069510
ISN        35             END IF                                                              G0069520
                 C           THE FOLLOWING GETS DONE WHETHER OR NOT JCSM IS TRUE.              G0069530
                 C           IF JCSM IS TRUE, THEN THE DSCALE ARE THE SAME AS WAS USED         G0069540
                 C           IN THE PREVIOUS ITERATION.                                        G0069550
ISN        36             DO 320 JGRPJ=1,NGRPS                                                G0069560
ISN        37                DO 310 JEQN=1,NVARS                                              G0069570
ISN        38                   FF2D(JEQN,JGRPJ)=FF2D(JEQN,JGRPJ)/DSCALE(JEQN,JGRPJ)         G0069580
ISN        39   310          CONTINUE                                                         G0069590
ISN        40   320       CONTINUE                                                            G0069600
                 C                                                                           G0069610
ISN        41             RETURN                                                              G0069620
ISN        42             END                                                                 G0069630
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*STATISTICS*   SOURCE STATEMENTS = 41, PROGRAM SIZE = 3008 BYTES, PROGRAM NAME = ALSCAL    PAGE: 145.

*STATISTICS*    NO DIAGNOSTICS GENERATED.

**ALSCAL** END OF COMPILATION 29 **********
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OPTIONS IN EFFECT:  NOLIST NOMAP NOXREF NOGOSTMT NODECK   SOURCE   TERM NOOBJECT FIXED  NOTEST   TRMFLG   SRCFLG
                    NOSYM NORENT   SDUMP AUTODBL(NONE)   NOSXM    IL
                      OPT(0) LANGLVL(77) NOFIPS   FLAG(I)  NAME(MAIN  ) LINECOUNT(60)      CHARLEN(500)

                 *....*...1.....2.....3.....4.....5.....6.....7.*.....8
                 C.ZERORC                                                                          G0069640
                 C                                                                                 G0069650
                 C  500.  SET A ROW AND A COLUMN OF MATRIX A TO ZERO.                              G0069660
                 C                                                                                 G0069670
ISN         1            SUBROUTINE ZERORC(A,LDA,NCS,FF2D,NVARS,NGRPMX,                         G0069680
                    1                  M,JGRPR,JEQN,JGRPC,JVAR)                                   G0069690
ISN         2            IMPLICIT DOUBLE PRECISION (A-H,K,O-Z)                                  G0069700
                 C                                                                                 G0069710
ISN         3            DOUBLE PRECISION A(LDA,NCS),FF2D(NVARS,NGRPMX)                         G0069720
                 C                                                                                 G0069730
ISN         4            COMMON/BASICS/ZERO,HALF,ONE,TWO                                        G0069740
ISN         5            COMMON/TABLS2/NRLGS,JGRPOF(16),JRLG(55),JGRPOR(54),                    G0069750
                    1                 JGPTNR(55),JTYFRM(55),JTYRFL(55),JRFLIM(55)                G0069760
                 C                                                                                 G0069770
ISN         6            FF2D(JEQN,JGRPR)=ZERO                                                  G0069780
                 C                                                                                 G0069790
ISN         7            JR=(JRLG(JGRPR)-1)*NVARS+JEQN                                          G0069800
ISN         8            DO 120 J=1,N                                                           G0069810
ISN         9               A(JR,J)=ZERO                                                        G0069820
ISN        10         120 CONTINUE                                                              G0069830
                 C                                                                                 G0069840
ISN        11            JC=(JRLG(JGRPC)-1)*NVARS+JVAR                                          G0069850
ISN        12            DO 140 J=1,N                                                           G0069860
ISN        13               A(J,JC)=ZERO                                                        G0069870
ISN        14         140 CONTINUE                                                              G0069880
                 C                                                                                 G0069890
ISN        15            A(JR,JC)=ONE                                                           G0069900
                 C                                                                                 G0069910
ISN        16            RETURN                                                                 G0069920
ISN        17            END                                                                    G0069930
                                                                                                  G0069940

*STATISTICS*   SOURCE STATEMENTS = 17, PROGRAM SIZE = 1776 BYTES, PROGRAM NAME = ZERORC    PAGE:  147.

*STATISTICS*    NO DIAGNOSTICS GENERATED.

**ZERORC** END OF COMPILATION 30 **********
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OPTIONS IN EFFECT:  NOLIST NOMAP NOXREF NOGOSTMT NODECK   SOURCE   TERM NOOBJECT FIXED  NOTEST   TRMFLG   SRCFLG
                    NOSYM NORENT   SDUMP AUTODBL(NONE)   NOSXM    IL
                      OPT(0) LANGLVL(77) NOFIPS   FLAG(I)  NAME(MAIN  ) LINECOUNT(60)      CHARLEN(500)

                 *....*...1.....2.....3.....4.....5.....6.....7.*.....8
                 C.ALSOLV                                                                          G0069950
                 C                                                                                 G0069960
                 C  500.  SOLVE THE LINEAR EQUATIONS FOR THE "DISPLACEMENTS".                      G0069970
                 C                                                                                 G0069980
ISN         1            SUBROUTINE ALSOLV(JCSM,LFULL,NCONMX,NUMAX,NGRPMX,NVARS,                G0069990
                    1                  COEFFS,FF2D,FFMCU,                                         G0070000
                    2                  ML,MU,AJACBN,LDA,Z,U1D,U,IPVT,ERYNCD)                      G0070010
ISN         2            IMPLICIT DOUBLE PRECISION (A-H,K,O-Z)                                  G0070020
                 C                                                                                 G0070030
ISN         3            DOUBLE PRECISION COEFFS(NVARS,NVARS,NCONMX)                            G0070040
ISN         4            DOUBLE PRECISION RCOND,AJACBN(LDA,NUMAX),Z(NUMAX),U1D(NUMAX)           G0070050
ISN         5            DOUBLE PRECISION FF2D(NVARS,NGRPMX),U(NUMAX,1)                         G0070060
ISN         6            DOUBLE PRECISION FFMCU(NVARS,NGRPMX)                                   G0070070
ISN         7            INTEGER ERYNCD,IPVT(NUMAX)                                             G0070080
ISN         8            LOGICAL JCSM,LFULL                                                     G0070090
                 C ***************************************************************************** G0070100
                 CINFO INTEGER JPVT(105)                                                           G0070110
                 CINFO DOUBLE PRECISION WORK(105),ORAUX(105)                                       G0070120
                 CINFO DOUBLE PRECISION S(105),E(105),UU(105,105),VV(105,105)                      G0070130
                 C ***************************************************************************** G0070140
                 C                                                                                 G0070150
ISN         9            LOGICAL SMIT1,SMIT2,SMIT3,SMIT4,SMIT5,SMIT6,SMIT7,SMIT8                G0070160
ISN        10            LOGICAL LFRNT                                                          G0070170
ISN        11            LOGICAL OUTLIE                                                         G0070180
                 C                                                                                 G0070190
ISN        12            COMMON/CPUTIM/CPUOLD,DELCPU(18)                                        G0070200
ISN        13            COMMON/SMIT   /SMIT1,SMIT2,SMIT3,SMIT4,SMIT5,SMIT6,SMIT7,SMIT8         G0070210
ISN        14            COMMON/BASICS/ZERO,HALF,ONE,TWO                                        G0070220
ISN        15            COMMON/IBASCS/NULL                                                     G0070230
ISN        16            COMMON/TABLS1/NBLKS,NGRPS,JGRPOG(50),JAGPOF(9,16),                     G0070240
                    1                 JBLK(45),JFRT(55)                                          G0070250
ISN        17            COMMON/TABL1A/LFRNT(55)                                                G0070260
ISN        18            COMMON/YALCO1/NUS,NCONXS,JBDIAG,J1CONX(55),NNEIBS(55),                 G0070270
                    1                 JGRPOC(715),JNEIBA(715)                                    G0070280
ISN        19            COMMON/YALCOL/OUTLIE(715)                                              G0070290
ISN        20            COMMON/TABLS2/NRLGS,JGRPOF(16),JRLG(55),JGRPOR(54),                    G0070300
                    1                 JGPTNR(55),JTYFRM(55),JTYRFL(55),JRFLIM(55)                G0070310
                 C                                                                                 G0070320
                 CTEST IF (1.EQ.1) STOP                                                            G0070330
ISN        21            IF ( .NOT.SMIT3) THEN                                                  G0070340
ISN        22               ICHECK=1                                                            G0070350
ISN        23               CPUNEW=UTTIMR(1)                                                    G0070360
ISN        24               CPUINC=CPUNEW-CPUOLD                                                G0070370
ISN        25               DELCPU(ICHECK)=CPUINC                                               G0070380
ISN        26               CPUOLD=CPUNEW                                                       G0070390
ISN        27               WRITE(6,47990)ICHECK,CPUNEW,CPUINC                                  G0070400
ISN        28               DELCPU(ICHECK)=CPUINC                                               G0070410
ISN        29            END IF                                                                 G0070420
ISN        30   47990 FORMAT(' AT CHECKPOINT ',I2,' THE TOTAL TIME IS ',F8.4,                    G0070430
                    1  ' SEC. WITH ',F7.4,' SEC. SINCE THE PREVIOUS CHECKPOINT.')             G0070440
ISN        31            ERYNCD=0                                                               G0070450
                 C                                                                                 G0070460
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                 *....*...1.........2.........3.........4.........5.........6.........7.*.......8

ISN       32         IF (JCSN) GO TO 500                                                    G0070470
                  C                                                                       G0070480
                  CCC      CALCULATE NROWS.                                               G0070490
                  C                                                                       G0070500
ISN       33         IF (LFULL) THEN                                                      G0070510
ISN       34           NROWS=NGRPS*NVARS                                                  G0070520
ISN       35           ELSE                                                               G0070530
                  C                                                                       G0070540
                  CCC        CALCULATE ML, MU, JDIAG.                                     G0070550
                  CCC                                                                     G0070560
                  C          IN MBU AND MBL, THE "B" STANDS FOR "BLOCKS".                 G0070570
ISN       36           MBU=0                                                              G0070580
ISN       37           MBL=0                                                              G0070590
ISN       38           DO 190 JCONXJ=1,NCONXS                                             G0070600
ISN       39             IF (.NOT.OUTLIE(JCONXJ)) THEN                                    G0070610
ISN       40               JBDIF=JRLG(JGRPOC(JCONXJ))-JRLG(JNEIBR(JCONXJ))                G0070620
ISN       41               MBU=MAXO(MBU, JBDIF)                                           G0070630
ISN       42               MBL=MAXO(MBL,-JBDIF)                                           G0070640
ISN       43             END IF                                                           G0070650
ISN       44    190    CONTINUE                                                          G0070660
ISN       45           MU=(MBU+1)*NVARS-1                                                 G0070670
ISN       46           ML=(MBL+1)*NVARS-1                                                 G0070680
ISN       47           JDIAG=MU+ML+1                                                      G0070690
                  C          JBDIAG IS EITHER MBU+1 OR MBL+1 .                          G0070700
ISN       48           NROWS=JDIAG+ML                                                     G0070710
ISN       49         END IF                                                               G0070720
ISN       50    202 FORMAT(' ******ALSOLV; FATAL ERROR: NROWS (=',I4,') IS LARGER',      G0070730
                 1                                THAN LDA   (=',I4,').')                G0070740
ISN       51         IF (NROWS.GT.LDA) WRITE(6,202)NROWS,LDA                              G0070750
ISN       53         IF (NROWS.GT.LDA) WRITE(9,202)NROWS,LDA                              G0070760
                  C                                                                       G0070770
                  CCC      DID YOU DO FF2D --> U1D --> SOLVE --> U1D --> U  QMARK        G0070780
                  CCC                                                                     G0070790
                  CCC      TRANSFER COEFFS TO AJACBN, BUT FIRST INITIALISE.              G0070800
                  C                                                                       G0070810
ISN       55         DO 220 JU=1,NUS                                                      G0070820
ISN       56           DO 210 JROW=1,NROWS                                                G0070830
ISN       57             AJACBN(JROW,JU)=ZERO                                             G0070840
ISN       58    210    CONTINUE                                                          G0070850
ISN       59    220  CONTINUE                                                            G0070860
ISN       60         IF (LFULL) THEN                                                      G0070870
ISN       61           DO 260 JCONXJ=1,NCONXS                                             G0070880
                  C            COMPUTE LOCATION OF TOP LEFT CORNER OF SUBMATRIX.        G0070890
ISN       62             JRLGJU=JRLG(JGRPOC(JCONXJ))                                      G0070900
ISN       63             JRLGJR=JRLG(JNEIBR(JCONXJ))                                      G0070910
ISN       64             JUCORN=(JRLGJU-1)*NVARS+1                                        G0070920
ISN       65             JRCORN=(JRLGJR-1)*NVARS+1                                        G0070930
                  C            TRANSFER THE SUBMATRIX.                                  G0070940
ISN       66             DO 250 JVAR=1,NVARS                                              G0070950
ISN       67               JUELT=JUCORN+JVAR-1                                            G0070960
ISN       68               DO 240 JEQN=1,NVARS                                            G0070970
ISN       69                 JRELT=JRCORN+JEQN-1                                          G0070980
ISN       70                 AJACBN(JRELT,JUELT)=COEFFS(JEQN,JVAR,JCONXJ)                 G0070990
ISN       71    240          CONTINUE                                                     G0071000
ISN       72    250        CONTINUE                                                       G0071010
ISN       73    260      CONTINUE                                                         G0071020
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                 *....*...1.........2.........3.........4.........5.........6.........7.*.......8

ISN       74           ELSE                                                               G0071030
ISN       75             DO 290 JCONXJ=1,NCONXS                                           G0071040
ISN       76               IF (.NOT.OUT(IE(JCONXJ)) THEN                                  G0071050
                  C                COMPUTE LOCATION OF TOP LEFT CORNER OF SUBMATRIX.     G0071060
ISN       77                 JRLGJU=JRLG(JGRPOC(JCONXJ))                                G0071070
ISN       78                 JRLGJR=JRLG(JNEIBR(JCONXJ))                                G0071080
ISN       79                 JUCORN=(JRLGJU-1)*NVARS+1                                  G0071090
ISN       80                 JRCORN=JDIAG+(JRLGJR-JRLGJU)*NVARS                         G0071100
                  C                TRANSFER THE SUBMATRIX.                              G0071110
ISN       81                 DO 280 JVAR=1,NVARS                                        G0071120
ISN       82                   JUELT=JUCORN+JVAR-1                                      G0071130
ISN       83                   DO 270 JEQN=1,NVARS                                      G0071140
ISN       84                     JRELT=JRCORN+JEQN-JVAR                                 G0071150
ISN       85                     AJACBN(JRELT,JUELT)=COEFFS(JEQN,JVAR,JCONXJ)           G0071160
ISN       86    270              CONTINUE                                               G0071170
ISN       87    280            CONTINUE                                                 G0071180
ISN       88                 END IF                                                     G0071190
ISN       89    290        CONTINUE                                                     G0071200
ISN       90           END IF                                                           G0071210
                  C                                                                     G0071220
                  CCC      WRITE OUT AJACBN, REPEATING SOME COLUMNS.  IS DISABLED.      G0071230
                  C                                                                     G0071240
                  302 FORMAT('  '///' AJACBN ',12I10/'  ')  IS DISABLED.              G0071250
                  303 FORMAT(1X,'AJACBN ',I3,1X,12D10.2)  IS DISABLED.                  G0071260
                  C     NINC=10  IS DISABLED.                                           G0071270
                  C     DO 350 JUSTA=1,NUS,NINC  IS DISABLED.                           G0071280
                  C       JUEND=MINO(JUSTA+NINC-1,NUS)  IS DISABLED.                    G0071290
                  C       WRITE(6,302)(JU,JU=JUSTA,JUEND)  IS DISABLED.                 G0071300
                  C       DO 340 JROW=1,NROWS  IS DISABLED.                             G0071310
                  C         WRITE(6,303)JROW,(AJACBN(JROW,JU),JU=JUSTA,JUEND)  DISABLED.G0071320
                  C340    CONTINUE  IS DISABLED.                                        G0071330
                  C350  CONTINUE  IS DISABLED.                                          G0071340
                  C*************************************************************************G0071350
                  CCC      THIS IS A GOOD PLACE FROM WHICH TO CALL ZERORC.              G0071360
                  CCC                                                                   G0071370
                  CCC      DUMP AJACBN TO DISK.                                         G0071380
                  CINFO REWIND 4                                                        G0071390
                  CINFO WRITE(4)AJACBN                                                  G0071400
                  CINFO  END FILE(4)                                                    G0071410
                  CCC                                                                   G0071420
                  CINFO NN=NUS                                                          G0071430
                  CINFO LDX=LDA                                                         G0071440
                  CINFO NP =NN                                                          G0071450
                  CCC                                                                   G0071460
                  CCC      OR DECOMPOSITION.                                            G0071470
                  CCC                                                                   G0071480
                  CCC      AJACBN MUST BE IN THE FULL-MATRIX FORMAT.                    G0071490
                  CCC                                                                   G0071500
                  CINFO IF (.NOT.LFULL) THEN                                            G0071510
                  CCC        CONVERT AJACBN IN-PLACE TO FULL FORMAT.                    G0071520
                  CINFO     JDM1=JDIAG-1                                               G0071530
                  CINFO     JDP1=JDIAG+1                                               G0071540
                  C           SHIFT SOME COLUMNS UP.                                   G0071550
                  CINFO     DO 354 JC=1,JDM1                                           G0071560
                  CINFO       JSHIFT=JDIAG-JC                                          G0071570
                  CINFO       JRSTA=JSHIFT+1                                           G0071580
```

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*....*...1.........2.........3.........4.........5.........6.........7.*.......8
C                THE FIRST TIME THROUGH, ROW #1 IS FILLED.                      G0071590
C                THE  LAST TIME THROUGH, ROW #NROWS IS EMPTIED.                 G0071600
CINFO         DO 353 JR=JRSTA,NROWS                                             G0071610
CINFO            AJACBN(JR-JSHIFT,JC)=AJACBN(JR,JC)                             G0071620
CINFO            AJACBN(JR,JC)=ZERO                                             G0071630
CINF9 353        CONTINUE                                                       G0071640
CINF9 354      CONTINUE                                                         G0071650
C             SHIFT OTHER COLUMNS DOWN.                                         G0071660
CINFO      DO 356 JC=JDP1,NN                                                   G0071670
CINFO         JSHIFT=JC-JDIAG                                                  G0071680
C                JR + JSHIFT     <= NN                                         G0071690
C                JR              <= NN - JSHIFT                                G0071700
C                NROWS + 1 - JR >= NROWS + 1 - ( NN - JSHIFT )                 G0071710
C                JRBACK         >= ( NROWS + 1 - NN ) + JSHIFT                 G0071720
CINFO         JRBSTA=MAXO(1,(NROWS+1-NN)+JSHIFT)                               G0071730
CINFO         JRBFIN=NROWS                                                     G0071740
CINFO         DO 355 JRBACX=JRBSTA,JRBFIN                                      G0071750
CINFO            JR=NROWS+1-JRBACX                                             G0071760
CINFO            AJACBN(JR+JSHIFT,JC)=AJACBN(JR,JC)                            G0071770
CINFO            AJACBN(JR,JC)=ZERO                                            G0071780
CINF9 355           CONTINUE                                                   G0071790
CINF9 356        CONTINUE                                                      G0071800
CINFO      END IF                                                              G0071810
C          PRINT OUT AJACBN., IS DISABLED.                                     G0071820
C 362 FORMAT(' ',///,' AAA  12110/'          IS DISABLED.                     G0071830
C 363 FORMAT(1X,'AAA ',I3,1X,12D10.2)  IS DISABLED.                           G0071840
C     NINC=10  IS DISABLED                                                    G0071850
C        DO 368 JUSTA=1,NUS,NINC  IS DISABLED.                                G0071860
C           JUEND=MINO(JUSTA+NINC-1,NUS)  IS DISABLED.                        G0071870
C           WRITE(6,362)(JU,JU=JUSTA,JUEND)  IS DISABLED.                     G0071880
C           DO 366 JROW=1,NN  IS DISABLED.                                    G0071890
C              WRITE(6,363)JROW,(AJACBN(JROW,JU),JU=JUSTA,JUEND)  DISABLED.   G0071900
C 366       CONTINUE  IS DISABLED.                                            G0071910
C 368 CONTINUE  IS DISABLED.                                                  G0071920
C        NOW DO THE QR DECOMPOSITION.                                         G0071930
CINFO DO 371 JK=1,NP                                                          G0071940
CINFO    JPVT(JK)=0                                                           G0071950
CINF9 371 CONTINUE                                                            G0071960
C        ALL COLUMNS ARE FREE TO PIVOT.                                       G0071970
CINFO JOBQRD=1                                                                G0071980
C        JOBQRD=1 MEANS PIVOT.                                                G0071990
C        JPVT(J) WILL CONTAIN THE INDEX OF THE COLUMN THAT WAS MOVED           G0072000
C        >> INTO << COLUMN J.                                                 G0072010
C                                                                             G0072020
CINFO CALL DORDC(AJACBN,LDX,NN,NP,QRAUX,JPVT,WORK,JOBQRD)                     G0072030
C                                                                             G0072040
CINF9 374 FORMAT(' QRD')                                                      G0072050
CINF9 375 FORMAT(' QRD-DIAGONAL:',5D16.8)                                     G0072060
CINFO JGRPSZ=5                                                                G0072070
CINFO WRITE(6,374)                                                            G0072080
CINFO DO 378 JSTART=1,NN,JGRPSZ                                               G0072090
CINFO    JFINIS=MINO(JSTART+JGRPSZ-1,NN)                                      G0072100
CINFO    WRITE(6,375)(AJACBN(J,J),J=JSTART,JFINIS,1)                          G0072110
CINF9 378 CONTINUE                                                            G0072120
C                                                                             G0072130
C        THE SINGULAR VALUE DECOMPOSITION.                                    G0072140
```



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*....*...1.........2.........3.........4.........5.........6.........7.*.......8
C                                                                             G0072150
C        CALCULATE AJACBN AGAIN THE SAME OLD WAY.                             G0072160
CINFO REWIND 4                                                                G0072170
CINFO READ(4)AJACBN                                                           G0072180
CINFO IF (.NOT.LFULL) THEN                                                    G0072190
C           CONVERT AJACBN IN-PLACE TO FULL FORMAT.                           G0072200
CINFO       JDM1=JDIAG-1                                                      G0072210
CINFO       JDP1=JDIAG+1                                                      G0072220
C           SHIFT SOME COLUMNS UP.                                            G0072230
CINFO       DO 384 JC=1,JDM1                                                  G0072240
CINFO          JSHIFT=JDIAG-JC                                                G0072250
CINFO          JRSTA=JSHIFT+1                                                 G0072260
C                 THE FIRST TIME THROUGH, ROW #1 IS FILLED.                   G0072270
C                 THE  LAST TIME THROUGH, ROW #NROWS IS EMPTIED.              G0072280
CINFO          DO 383 JR=JRSTA,NROWS                                          G0072290
CINFO             AJACBN(JR-JSHIFT,JC)=AJACBN(JR,JC)                          G0072300
CINFO             AJACBN(JR,JC)=ZERO                                          G0072310
CINF9 383         CONTINUE                                                    G0072320
CINF9 384       CONTINUE                                                      G0072330
C              SHIFT OTHER COLUMNS DOWN.                                      G0072340
CINFO       DO 386 JC=JDP1,NN                                                 G0072350
CINFO          JSHIFT=JC-JDIAG                                                G0072360
C                 JR + JSHIFT     <= NN                                       G0072370
C                 JR              <= NN - JSHIFT                              G0072380
C                 NROWS + 1 - JR >= NROWS + 1 - ( NN - JSHIFT )               G0072390
C                 JRBACK         >= ( NROWS + 1 - NN ) + JSHIFT               G0072400
CINFO          JRBSTA=MAXO(1,(NROWS+1-NN)+JSHIFT)                             G0072410
CINFO          JRBFIN=NROWS                                                   G0072420
CINFO          DO 385 JRBACX=JRBSTA,JRBFIN                                    G0072430
CINFO             JR=NROWS+1-JRBACX                                           G0072440
CINFO             AJACBN(JR+JSHIFT,JC)=AJACBN(JR,JC)                          G0072450
CINFO             AJACBN(JR,JC)=ZERO                                          G0072460
CINF9 385         CONTINUE                                                    G0072470
CINF9 386       CONTINUE                                                      G0072480
CINFO       END IF                                                            G0072490
C           DON'T BOTHER PRINTING OUT AJACBN AGAIN.                           G0072500
C           NOW DO THE SINGULAR VALUE DECOMPOSITION.                          G0072510
CINFO LDU=NN                                                                  G0072520
CINFO LDV=NN                                                                  G0072530
CINFO NM =NN                                                                  G0072540
CINFO JOBSVD=11                                                               G0072550
C           I.E. COMPUTE UU AND COMPUTE VV.                                   G0072560
C                                                                             G0072570
CINFO CALL DSVDC(AJACBN,LDX,NN,NP,S,E,UU,LDU,VV,LDV,WORK,JOBSVD,INFO)         G0072580
CINF9 391 FORMAT(' SVD')                                                      G0072590
CINF9 392 FORMAT(' SVD INFO=',I4)                                             G0072600
CINF9 393 FORMAT(' SVD-DIAGONAL:',5D16.8)                                     G0072610
CINFO WRITE(6,391)                                                            G0072620
CINFO WRITE(6,392)INFO                                                        G0072630
CINFO DO 396 JSTART=1,NN,JGRPSZ                                               G0072640
CINFO    JFINIS=MINO(JSTART+JGRPSZ-1,NN)                                      G0072650
CINFO    WRITE(6,393)(S(J),J=JSTART,JFINIS,1)                                 G0072660
CINF9 396 CONTINUE                                                            G0072670
C                                                                             G0072680
CINFO REWIND 4                                                                G0072690
CINFO READ(4)AJACBN                                                           G0072700
```

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                      *....*...1.....2.....3.....4.....5.....6.....7.*.....8
                      C ***************************************************************G0072710
                      C                                                               G0072720
                      C        FACTOR, AND PRINT OUT IMPORTANT NUMBERS.               G0072730
                      C                                                               G0072740
ISN       91              IF (LFULL) THEN                                             G0072750
ISN       92                 CALL SGECO(AJACBN,LDA,NUS,IPVT,RCOND,Z)                  G0072760
ISN       93                 WRITE(6,401)RCOND                                        G0072770
ISN       94               ELSE                                                       G0072780
ISN       95                 CALL SGBCO(AJACBN,LDA,NUS,ML,MU,IPVT,RCOND,Z)            G0072790
ISN       96                 WRITE(6,402)RCOND                                        G0072800
ISN       97               END IF                                                     G0072810
                      C                                                               G0072820
ISN       98          401 FORMAT(1X,'RCOND:  SGECO HAS CALLED.  RCOND = ',D16.8)      G0072830
ISN       99          402 FORMAT(1X,'RCOND:  SGBCO HAS CALLED.  RCOND = ',D16.8)      G0072840
ISN      100          403 FORMAT(1X,'Z VECT'/55(1X,'Z VECT',5D11.3/))                 G0072850
                      C                                                               G0072860
                      C     WRITE(6,403)(Z(JU),JU=1,NUS)  HAS MOVED.                  G0072870
                      C                                                               G0072880
ISN      101              IF (RCOND.LT.1.0D-13) THEN                                  G0072890
ISN      102                 WRITE(6,403)(Z(JU),JU=1,NUS)                             G0072900
ISN      103                 IF (.NOT.LFULL) THEN                                     G0072910
                      C                PRINT THE DIAGONAL OF THE UPPER TRIANGULAR FACTOR.G0072920
ISN      104                    MLMUP1=ML+MU+1                                        G0072930
ISN      105          412       FORMAT(1X,'DIAGNL'/55(1X,'DIAGNL',5D11.3/))           G0072940
ISN      106                    WRITE(6,412)(AJACBN(MLMUP1,JU),JU=1,NUS)              G0072950
ISN      107                 END IF                                                   G0072960
ISN      108                 ERYNCO=1                                                 G0072970
ISN      109                 RETURN                                                   G0072980
ISN      110               END IF                                                     G0072990
                      C                                                               G0073000
ISN      111          500 CONTINUE                                                    G0073010
                      C                                                               G0073020
                      C        SOLVE FOR RIGHT-HAND-SIDE.                             G0073030
                      C                                                               G0073040
                      C        IT IS ASSUMED THAT NEQNS=NVARS.                        G0073050
ISN      112              DO 520 JGRPJ=1,NGRPS                                        G0073060
ISN      113                 DO 510 JEQN=1,NVARS                                      G0073070
ISN      114                    JU=(JRLG(JGRPJ)-1)*NVARS+JEQN                         G0073080
ISN      115                    U1D(JU)=FF2D(JEQN,JGRPJ)                              G0073090
ISN      116          510       CONTINUE                                              G0073100
ISN      117          520    CONTINUE                                                 G0073110
                      C                                                               G0073120
ISN      118              JOB=0                                                       G0073130
ISN      119              IF (    LFULL) CALL SGESL(AJACBN,LDA,NUS,IPVT,U1D,JOB)     G0073140
ISN      121              IF (.NOT.LFULL) CALL SGBSL(AJACBN,LDA,NUS,ML,MU,IPVT,U1D,JOB)G0073150
                      C                                                               G0073160
ISN      123              DO 580 JU=1,NUS                                             G0073170
ISN      124                 U(JU,1)=U1D(JU)                                          G0073180
ISN      125          580 CONTINUE                                                    G0073190
                      C                                                               G0073200
                      C        CHECK THE SOLUTION.                                    G0073210
ISN      126              DO 620 JGRPJ=1,NGRPS                                        G0073220
ISN      127                 DO 610 JEQN=1,NVARS                                      G0073230
ISN      128                    IF (JRLG(JGRPJ).GT.NULL) FFMCU(JEQN,JGRPJ)=FF2D(JEQN,JGRPJ)G0073240
ISN      130                    IF (JRLG(JGRPJ).LE.NULL) FFMCU(JEQN,JGRPJ)=ZERO      G0073250
ISN      132          610       CONTINUE                                              G0073260
```



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                      *....*...1.....2.....3.....4.....5.....6.....7.*.....8
ISN      133          620 CONTINUE                                                    G0073270
                      C                                                               G0073280
ISN      134              DO 650 JCONXJ=1,NCONXS                                      G0073290
ISN      135                 IF (LFULL.OR..NOT.OUTLIE(JCONXJ)) THEN                   G0073300
ISN      136                    JGRPU=JGRPOC(JCONXJ)                                  G0073310
ISN      137                    JGRPF=JNEIBR(JCONXJ)                                  G0073320
ISN      138                    DO 640 JEQN=1,NVARS                                   G0073330
ISN      139                       SUM=ZERO                                           G0073340
ISN      140                       JUO=(JRLG(JGRPU)-1)*NVARS                          G0073350
ISN      141                       DO 630 JVAR=1,NVARS                                G0073360
ISN      142                          SUM=SUM+COEFFS(JEQN,JVAR,JCONXJ)*U1D(JUO+JVAR)  G0073370
ISN      143          630             CONTINUE                                       G0073380
ISN      144                       FFMCU(JEQN,JGRPF)=FFMCU(JEQN,JGRPF)-SUM           G0073390
ISN      145          640          CONTINUE                                          G0073400
ISN      146                    END IF                                               G0073410
ISN      147          650    CONTINUE                                                G0073420
                      C                                                               G0073430
ISN      148              IF (.NOT.SWIT7) THEN                                        G0073440
ISN      149                 DO 680 JGRPJ=1,NGRPS                                     G0073450
ISN      150                    WRITE(6,678)JGRPJ,(FFMCU(JEQN,JGRPJ),JEQN=1,NVARS),  G0073460
                     1                         (FF2D(JEQN,JGRPJ),JEQN=1,NVARS)      G0073470
ISN      151          678       FORMAT(' FFMCU: ',I3,4X,5D10.2,4X,5D10.2/)          G0073480
ISN      152          680       CONTINUE                                            G0073490
ISN      153                 END IF                                                   G0073500
                      C                                                               G0073510
ISN      154              IF (.NOT.SWIT3) THEN                                        G0073520
ISN      155                 ICHECK=2                                                 G0073530
ISN      156                 CPUNEW=UTTIMR(1)                                         G0073540
ISN      157                 CPUINC=CPUNEW-CPUOLD                                     G0073550
ISN      158                 DELCPU(ICHECK)=CPUINC                                    G0073560
ISN      159                 CPUOLD=CPUNEW                                            G0073570
ISN      160                 WRITE(6,47990)ICHECK,CPUNEW,CPUINC                       G0073580
ISN      161                 DELCPU(ICHECK)=CPUINC                                    G0073590
ISN      162               END IF                                                     G0073600
                      C                                                               G0073610
ISN      163              RETURN                                                      G0073620
ISN      164              END                                                         G0073630
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STATISTICS SOURCE STATEMENTS = 158, PROGRAM SIZE = 8364 BYTES, PROGRAM NAME = ALSOLV PAGE: 148.

STATISTICS NO DIAGNOSTICS GENERATED.

ALSOLV END OF COMPILATION 31 ******

OPTIONS IN EFFECT: NOLIST NOMAP NOXREF NOGOSTMT NODECK SOURCE TERM NOOBJECT FIXED NOTEST TRMFLG SRCFLG
NOSYM NORENT SDUMP AUTODBL(NONE) NOSXM IL
OPT(0) LANGLVL(77) NOFIPS FLAG(I) NAME(MAIN) LINECOUNT(60) CHARLEN(500)

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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
                C.ALAJST
                C
                C  500.  ADJUST THE VALUES OF THE STATE VARIABLES (THIS IS DUAL-PURPOSE)G0073640
                C                                                                      G0073650
ISN       1               SUBROUTINE ALAJST(JCCALC,FDAMP ,U1D                          G0073660
                1                       TEST ,NGRPMX,NFPTMX,NNELMX,NBNDMX,NBLKMX,    G0073670
                2                       NDIRMX,NEDGMX,NCOMMX,NUMAX ,NATRMX,NOMAX ,   G0073680
                3                       NMCS ,NCOMPS,NVARS ,NBALNS,                  G0073690
                4                       ACCUMO,FLTMXO,FLTMYO,FLTMTO,                 G0073700
                5                       EHMCFO,VOLCFO,FLORMO,ACUMFO,FLOMO ,          G0073710
                6                       GVCXMO,GVCXYO,GVCYMO,GVCYYO,                 G0073720
                7                       DXCFLO,DYCFLO,SPLITO,SRCETO,                 G0073730
                8                       FF2DO ,COEFFS,LCONV ,REPEAT)                 G0073740
                C                                                                      G0073750
                CCCC                                                                   G0073760
                CCCC    JCCALC - IF FALSE, THEN UPDATE  EACH VARIABLE                  G0073770
                CCCC           - IF  TRUE, THEN PERTURB EACH VARIABLE                  G0073780
                CCCC                 AND CALCULATE THE JACOBIAN ELEMENTS.              G0073790
ISN       2               IMPLICIT DOUBLE PRECISION (A-H,K,O-Z)                        G0073800
                C                                                                      G0073810
ISN       3               DOUBLE PRECISION U1D(NUMAX)                                  G0073820
ISN       4               DOUBLE PRECISION COEFFS(NVARS,NVARS,NCOMMX)                  G0073830
ISN       5               DOUBLE PRECISION FF2DO(NVARS,NGRPMX)                         G0073840
ISN       6               LOGICAL TEST ,LFICT                                          G0073850
ISN       7               LOGICAL JCCALC,DRYKM1,DRYKMO,OVERSH,REPEAT                   G0073860
ISN       8               LOGICAL LCONV(NUMAX)                                         G0073870
ISN       9               DOUBLE PRECISION ACCUMO(NBALNS,NGRPMX)                       G0073880
ISN      10               DOUBLE PRECISION ACUMFO(NBALNS,NFPTMX)                       G0073890
ISN      11               DOUBLE PRECISION  FLOMO(NBALNS,NEDGMX)                       G0073900
ISN      12               DOUBLE PRECISION FLORMO(   2  ,NEDGMX)                       G0073910
ISN      13               DOUBLE PRECISION EHMCFO(NCOMPS,NGRPMX)                       G0073920
ISN      14               DOUBLE PRECISION VOLCFO(NCOMPS,NGRPMX)                       G0073930
ISN      15               DOUBLE PRECISION FLTMXO(NBALNS,NEDGMX)                       G0073940
ISN      16               DOUBLE PRECISION FLTMYO(NBALNS,NEDGMX)                       G0073950
ISN      17               DOUBLE PRECISION FLTMTO(NBALNS,NEDGMX)                       G0073960
ISN      18               DOUBLE PRECISION GVCXMO(NGRPMX),GVCYMO(NGRPMX)               G0073970
ISN      19               DOUBLE PRECISION GVCXYO(NGRPMX),GVCYYO(NGRPMX)               G0073980
ISN      20               DOUBLE PRECISION DXCFLO(NBALNS),DYCFLO(NBALNS)               G0073990
ISN      21               DOUBLE PRECISION SPLITO(NDIRMX,NNELMX)                       G0074000
ISN      22               DOUBLE PRECISION SRCETO(NBALNS,NDIRMX,NNELMX)                G0074010
                C                                                                      G0074020
ISN      23               LOGICAL EQMA01,EQMA10,VOUCPT,VOUCSC,EQUIL                    G0074030
ISN      24               LOGICAL COORTR,TRACKF,OVTAKE,DATAFR,RESTRT                   G0074040
ISN      25               LOGICAL SMIT1,SMIT2,SMIT3,SMIT4,SMIT5,SMIT6,SMIT7,SMIT8      G0074050
ISN      26               CHARACTER*4 HORZ,VERT                                        G0074060
ISN      27               LOGICAL LFRNT                                                G0074070
ISN      28               LOGICAL LBNDOG,LBNDB                                         G0074080
ISN      29               LOGICAL RCOND,INJECT                                         G0074090
ISN      30               LOGICAL BLSPEC                                               G0074100
ISN      31               LOGICAL L2SYMM,LCIRCL                                        G0074110
ISN      32               LOGICAL LNEWHR,LMELL                                         G0074120
                C                                                                      G0074130
ISN      33               COMMON/ISTAGE/ITIME,ITERAT                                   G0074140
                                                                                       G0074150
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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
ISN      34               COMMON/PRMBLK/SMC,SOIR2,SGIRR,SGPDUM,SMPDUM,KRGDUM,KROG,KROW,G0074160
                1                       KRWDUM,KRODUM,KRGSGD,KROGSG,KROWSW,KRWSWD,KROSGD,G0074170
                2                       KROSWD,PCMDUM,PCVDUM,                        G0074180
ISN      35               COMMON/EQLBRM/PEQUIL,                                        G0074190
                1                       EQMA01,EQMA10,VOUCPT,VOUCSC,EQUIL(55)        G0074200
ISN      36               COMMON/GRIPRO/DT,DXFRNT,DISXM,DX(57),DIST(28),MFRONT,NBLOKS, G0074210
                1                       NG,NJAY,COORTR,TRACKF,OVTAKE,DATAFR,RESTRT   G0074220
ISN      37               COMMON/STATEV/SMO(55),SGP(55),SOP(55),T(55),P(55),           G0074230
                1                       XMOLE(3,55),XO(55),XSOL(55),XW(55),          G0074240
ISN      38               COMMON/CPUTIM/CPUOLD,DELCPU(18)                              G0074250
ISN      39               COMMON/SMIT  /SMIT1,SMIT2,SMIT3,SMIT4,SMIT5,SMIT6,SMIT7,SMIT8G0074260
ISN      40               COMMON/BASICS/ZERO,HALF,ONE,TWO                              G0074270
ISN      41               COMMON/DIMENS/NDIMRS,NTS,MY,MOS,NRS,NRFN,NRFP                G0074280
ISN      42               COMMON/DIRXNC/HORZ,VERT                                      G0074290
ISN      43               COMMON/FRONT3/FPDIST(16),FPDISX(16),FPDISY(16),FPDSNM(16)    G0074300
ISN      44               COMMON/TABLS1/NBLKS,NGRPS,JGRPOG(50),JAGPOF(9,16),           G0074310
                1                       JBLK(45),JFPT(55)                            G0074320
ISN      45               COMMON/TABL1A/LFRNT(55)                                      G0074330
ISN      46               COMMON/BTBLS1/NBNDBS,JBNDOG(55),JBNDB(50),JBLKDB(28),JINTOB(28)G0074340
ISN      47               COMMON/BTBL1A/LBNDOG(55),LBNDB(50)                           G0074350
ISN      48               COMMON/SPEC4 /RCOND(28),INJECT(28)                           G0074360
ISN      49               COMMON/BVOLFL/BVFLOW(28),FLFB(50)                            G0074370
ISN      50               COMMON/GRAVTY/GX,GY,DENMSM(55),DENMSO(55),DENMSV(55),GRAVP(55)G0074380
ISN      51               COMMON/YALCD1/NUS,NCONXS,JBDIAG,JICONX(55),NNEIBS(55),       G0074390
                1                       JGRPOC(715),JNEIBA(715)                      G0074400
ISN      52               COMMON/YALC02/NBANMX,JCONX(73,55)                            G0074410
ISN      53               COMMON/CBCORX/BLCORX(8,50)                                   G0074420
ISN      54               COMMON/CBCORY/BLCORY(8,50)                                   G0074430
ISN      55               COMMON/CBSPEC/BLSPEC(8,50)                                   G0074440
ISN      56               COMMON/CBAREA/BLAREA(50),CBAREA(50)                          G0074450
ISN      57               COMMON/GPXY  /GPX(55),GPY(55)                                G0074460
ISN      58               COMMON/EDLOCT/EDSTAX(150),EDSTAY(150),EDFINX(150),EDFINY(150)G0074470
ISN      59               COMMON/SCALES/SCALEP,SCALEM,SCALEY,SCALVF                    G0074480
ISN      60               COMMON/ADJACM/IFORMP,JUPGRP(16),JADJAC(4,55)                 G0074490
ISN      61               COMMON/LOGSYM/L2SYMM,LCIRCL                                  G0074500
ISN      62               COMMON/JTBIJ/JOFGRP(85),JOFGRP(55),JGRPIJ(36,24)             G0074510
ISN      63               COMMON/TABLS2/NRLGS,JGRPOF(16),JRLG(55),JGRPOM(54),          G0074520
                1                       JGPTNR(55),JTYFNR(55),JTYRFL(55),JRFLIN(55)  G0074530
ISN      64               COMMON/DGRID /DTHTAM(36),DTHTAP(36),DOPHSH(36),DTHETA(36),   G0074540
                1                       DFOMTH(36),DFOMTP(36),                       G0074550
                2                       DRPHSH(24),DRADM1(24),DRADP1(24)             G0074560
ISN      65               COMMON/FRNTCF/DCENDS,CENDIS,FRNDIS(36),DFRDTH(36),FRFRTH(36),G0074570
                1                       YFDOTH(36),XIRING(36),YIRING(36)             G0074580
ISN      66               COMMON/OFRNCF/OFRNDS(36)                                     G0074590
ISN      67               COMMON/WELLJ1/NWELLS,IENTNO(11),IENTNR(11),JGNEAR(11),       G0074600
                1                       JWELOC(55)                                   G0074610
ISN      68               COMMON/WELLLG/LNEWHR(11),LWELL(55)                           G0074620
                C                                                                      G0074630
ISN      69               IF (.NOT.JCCALC) THEN                                        G0074640
ISN      70                  DO 90 JU=1,NUS                                            G0074650
ISN      71                     LCONV(JU)=.FALSE.                                      G0074660
ISN      72                     U1D(JU)=U1D(JU)                                        G0074670
                C                 YES, THAT LOOKS STRANGE.                             G0074680
ISN      73            90    CONTINUE                                                 G0074690
ISN      74                 END IF                                                    G0074700
                                                                                       G0074710
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                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
C                                                                       G0074720
C       IT MIGHT BE DESIRABLE (EITHER FOR FLEXIBILITY OR TO SAVE        G0074730
C       COMPUTER TIME) TO MAKE THE FOLLOWING VARIABLES INPUT VARIABLES. G0074740
C       HOWEVER, THERE ARE PROBABLY OTHER DESIRABLE CHANGES WHICH       G0074750
C       DESERVE A HIGHER PRIORITY.                                      G0074760
C                                                                       G0074770
ISN     75          DELTK=1.0D-2                                        G0074780
ISN     76          DELPR=1.0D+1                                        G0074790
ISN     77          DELSP=1.0D-4                                        G0074800
ISN     78          DELXI=1.0D-4                                        G0074810
ISN     79          FDELF=1.0D-4                                        G0074820
ISN     80          DELLC=1.0D-5                                        G0074830
C             THIS IS A TEMPORARY (1985/01/10) FIX.                     G0074840
ISN     81          ABTOLP=1.0D-4                                       G0074850
ISN     82          ABTOLF=1.0D-5                                       G0074860
ISN     83          ABTOLT=1.0D-5                                       G0074870
ISN     84          ABTOLL=1.0D-4                                       G0074880
ISN     85          ABTOLS=1.0D-5                                       G0074890
ISN     86          ABTOLX=1.0D-5                                       G0074900
C             THIS IS A TEMPORARY (1985/08/14) FIX.                     G0074910
ISN     87          DO 950 JGRPJ=1,NGRPS                                G0074920
ISN     88            IF (COORTR) THEN                                  G0074930
ISN     89              IF (JTYRFL(JGRPJ).EQ.4) GO TO 950               G0074940
ISN     90            END IF                                            G0074950
C               FIRST COMPUTE THE GROUP CODE,                           G0074960
C               AND AT LEAST ONE OF JFPT,JBLK,JBNDB,JHELOG.             G0074970
C                                                                       G0074980
C               JGPCOD = 1  -  NO VAPOUR PHASE, INTERIOR BLOCK,         G0074990
C                              OR BOUNDARY BLOCK WITH FLOW-RATE SPECIFIED. G0075000
C                                                                       G0075010
C                      = 2  -  NO VAPOUR PHASE, BOUNDARY BLOCK          G0075020
C                              WITH PRESSURE SPECIFIED.                 G0075030
C                                                                       G0075040
C                      = 3  -  YES VAPOUR PHASE, INTERIOR BLOCK         G0075050
C                              OR BOUNDARY BLOCK WITH FLOW-RATE SPECIFIED. G0075060
C                                                                       G0075070
C                      = 4  -  YES VAPOUR PHASE, BOUNDARY BLOCK         G0075080
C                              WITH PRESSURE SPECIFIED.                 G0075090
C                                                                       G0075100
C                      = 5  -  A FRONT GROUP, NOT A GRID BLOCK GROUP.   G0075110
C                              FORMULATION #1 IS USED.                  G0075120
C                                                                       G0075130
C                      = 6  -  A FRONT GROUP, NOT A GRID BLOCK GROUP.   G0075140
C                              FORMULATION #2 IS USED.                  G0075150
C                                                                       G0075160
C                      = 7  -  A FRONT GROUP, NOT A GRID BLOCK GROUP.   G0075170
C                              FORMULATION #3 IS USED.                  G0075180
C                                                                       G0075190
C                      = 7  -  AN INNER FRONT GROUP,                    G0075200
C                              THE COORDINATE TRANSFORMATION METHOD IS USED. G0075210
C                                                                       G0075220
C                      = 8  -  AN OUTER FRONT GROUP,                    G0075230
C                              THE COORDINATE TRANSFORMATION METHOD IS USED. G0075240
C                                                                       G0075250
ISN     91            IF (COORTR) THEN                                  G0075260
ISN     92              LFICT=JTYRFL(JGRPJ).EQ.2                        G0075270
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                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
ISN     93              IF (LFICT) JGINAG=JRFLIM(JGRPJ)                 G0075280
ISN     95            ELSE                                              G0075290
ISN     96              LFICT=.FALSE.                                   G0075300
ISN     97            END IF                                            G0075310
ISN     98            IF (LFRNT(JGRPJ)) THEN                            G0075320
ISN     99              IF (COORTR) THEN                                G0075330
ISN    100                JGPCOD=5+JTYFRN(JGRPJ)                       G0075340
ISN    101              ELSE                                           G0075350
ISN    102                JGPCOD=5                                     G0075360
ISN    103                IF (IFORM.EQ.1) JGPCOD=6                     G0075370
ISN    105                JFPT=JFPT(JGRPJ)                             G0075380
ISN    106              END IF                                         G0075390
ISN    107            ELSE                                             G0075400
ISN    108              JGPCOD=1                                       G0075410
ISN    109              IF (EQUIL(JGRPJ)) JGPCOD=3                     G0075420
C               THE VALUE OF JGPCOD IS SUBJECT TO FURTHER CHANGE,       G0075430
C               IN THE NEXT FEW STATEMENTS.                             G0075440
ISN    111              IF (COORTR) THEN                               G0075450
ISN    112                IF (LHELL(JGRPJ)) THEN                       G0075460
ISN    113                  JHELJ=JHELOG(JGRPJ)                        G0075470
ISN    114                  IF (.NOT.RCOND(JHELJ)) JGPCOD=JGPCOD+1     G0075480
C                             I.E. EITHER 2 OR 4.                       G0075490
ISN    116                END IF                                       G0075500
ISN    117              ELSE                                           G0075510
ISN    118                JBLKJ=JBLK(JGRPJ)                            G0075520
ISN    119                IF (LBNDB(JBLKJ)) THEN                       G0075530
ISN    120                  JBNDBJ=JBNDB(JBLKJ)                        G0075540
ISN    121                  IF (.NOT.RCOND(JBNDBJ)) JGPCOD=JGPCOD+1    G0075550
C                             I.E. EITHER 2 OR 4.                       G0075560
ISN    123                END IF                                       G0075570
ISN    124              END IF                                         G0075580
ISN    125            END IF                                           G0075590
C                                                                       G0075600
ISN    126            JOFFST=(JGRPJ-1)*NVARS                           G0075610
ISN    127            DO 960 JVAR=1,NVARS                              G0075620
ISN    128              JU=JOFFST+JVAR                                 G0075630
C                                                                       G0075640
C                 DECIDE WHICH VARIABLE TO ADJUST.                      G0075650
ISN    129              GO TO (310,320,330,340,350,360,370,380),JGPCOD G0075660
C                                                                       G0075670
ISN    130       310      CONTINUE                                      G0075680
ISN    131              GO TO (560,570,570,510,530,570),JVAR           G0075690
C                                                                       G0075700
ISN    132       320      CONTINUE                                      G0075710
ISN    133              GO TO (560,570,570,520,530,570),JVAR           G0075720
C                                                                       G0075730
ISN    134       330      CONTINUE                                      G0075740
ISN    135              GO TO (560,570,570,550,510,570),JVAR           G0075750
C                                                                       G0075760
ISN    136       340      CONTINUE                                      G0075770
ISN    137              GO TO (560,570,570,520,550,570),JVAR           G0075780
C                                                                       G0075790
ISN    138       350      CONTINUE                                      G0075800
ISN    139              GO TO (560,570,570,510,540,570),JVAR           G0075810
C                                                                       G0075820
ISN    140       360      CONTINUE                                      G0075830
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                 *....*...1.........2.........3.........4.........5.........6.........7.*.......8
ISN      141                 GO TO (580,580,580,510,540,570),JVAR                                 G0075840
                 C                                                                                G0075850
ISN      142         370     CONTINUE                                                             G0075860
                 C DELETED:  IF (ITIME.LE.2.AND.ITERAT.LE.2.AND.JVAR.EQ.4) GO TO 580              G0075870
ISN      143                 GO TO (560,570,570,550,545,570),JVAR                                 G0075880
                 C                                                                                G0075890
ISN      144         380     CONTINUE                                                             G0075900
                 C DELETED:  IF (ITIME.LE.2.AND.ITERAT.LE.2.AND.JVAR.EQ.1) GO TO 580              G0075910
ISN      145                 GO TO (560,570,570,510,580,570),JVAR                                 G0075920
                 CCC                                                                              G0075930
                 CCC            ADJUST THE PRESSURE.                                              G0075940
                 C                                                                                G0075950
ISN      146         510     CONTINUE                                                             G0075960
ISN      147                 DELPR=1.0D+1                                                         G0075970
ISN      148                 DPMIN=DELPR                                                          G0075980
ISN      149                 JCNSTA=J1CONX(JGRPJ)                                                 G0075990
ISN      150                 JCNEND=JCNSTA+NNEIBS(JGRPJ)-1                                        G0076000
ISN      151                 DO 515 JCONXJ=JCNSTA,JCNEND                                          G0076010
ISN      152                 DPMIN=DMIN1(DPMIN,0.1D0*DABS(P(JGRPJ)-P(JNEIBR(JCONXJ))))           G0076020
ISN      153         515     CONTINUE                                                             G0076030
ISN      154                 PRTBTN=DMAX1(DPMIN,(1.0D-2*DELPR))                                   G0076040
                 C             SET PRTBTN TO 1.0D-2*DELPR IF DPMIN IS VERY SMALL.                 G0076050
ISN      155                 IF (JCCALC) THEN                                                     G0076060
ISN      156                   PO=P(JGRPJ)                                                        G0076070
                 C             TO=T(JGRPJ) HAS DELETED.                                           G0076080
ISN      157                   P(JGRPJ)=P(JGRPJ)+PRTBTN                                           G0076090
                 CCC                                                                              G0076100
                 CCC              THE CALL TO VPTEMP (ALIAS TEMPS) HAS BEEN DELETED.              G0076110
                 C                                                                                G0076120
                 C                                                                                G0076130
ISN      158                     CALL ALDRVS(JGRPJ,JVAR,PRTBTN,SCALEP,.TRUE.,.FALSE.,             G0076140
                1                          TEST  ,NGRPMX,NFPTMX,NNELMX,NBNDMX,NBLKMX,            G0076150
                2                          NDIRMX,NEDGMX,NCONMX,NUMAX ,NATRMX,NOMAX ,            G0076160
                3                          NMCS  ,NCOMPS,NVARS ,NBALNS,                          G0076170
                4                          ACCUMO,FLTMXO,FLTMYO,FLTMTO,                          G0076180
                5                          ENMCFO,VOLCFO,FLORHO,ACUMFO,FLOMO ,                   G0076190
                6                          GVCXMO,GVCXVO,GVCYMO,GVCYYO,                          G0076200
                7                          DXCFLO,DYCFLO,SPLITO,SRCETO,                          G0076210
                8                          FF2D0 ,COEFFS,LCONV ,REPEAT)                          G0076220
                 CCCCCCCCCCCCCCC              I.E. CALL ALDRVS(JGRPJ,JVAR,PRTBTN,SCALE,CALPRO,CALGRIG0076230
                 CCCCCCCCCCCCCCC                            ,TEST  ,NGRPMX,NFPTMX,NNELMX,NBNDMX,NBLKMX,G0076240
                 CCCCCCCCCCCCCCC                            NDIRMX,NEDGMX,NCONMX,NUMAX ,NATRMX,NOMAX ,G0076250
                 CCCCCCCCCCCCCCC                            NMCS  ,NCOMPS,NVARS ,NBALNS,              G0076260
                 CCCCCCCCCCCCCCC                            ACCUMO,FLTMXO,FLTMYO,FLTMTO,              G0076270
                 CCCCCCCCCCCCCCC                            ENMCFO,VOLCFO,FLORHO,ACUMFO,FLOMO ,       G0076280
                 CCCCCCCCCCCCCCC                            GVCXMO,GVCXVO,GVCYMO,GVCYYO,              G0076290
                 CCCCCCCCCCCCCCC                            DXCFLO,DYCFLO,SPLITO,SRCETO,              G0076300
                 C                                          FF2D0 ,COEFFS,LCONV ,REPEAT)              G0076310
ISN      159                     IF (IERR.NE.0) RETURN                                            G0076320
                 C                                                                                G0076330
ISN      161                     P(JGRPJ)=PO                                                      G0076340
                 C               T(JGRPJ)=TO HAS DELETED.                                         G0076350
                 CC                                                                               G0076360
ISN      162                     CALL SUPROP(JGRPJ,51)                                            G0076370
                 C                 I.E. CALL SUBROUTINE SUPROP(JGRPJ,LCTNPM)                      G0076380
ISN      163                     IF (IERR.NE.0) RETURN                                            G0076390
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                 *....*...1.........2.........3.........4.........5.........6.........7.*.......8
                 C                                                                                G0076400
ISN      165                   ELSE                                                               G0076410
ISN      166                     P(JGRPJ)=P(JGRPJ)+SCALEP*U1D(JU)*FDAMP                           G0076420
ISN      167                     IF (LFICT) P(JGIMAG)=P(JGRPJ)                                    G0076430
ISN      169                     U1DDIF = ( SCALEP*DABS(U1D(JU))/P(JGRPJ)                         G0076440
                1                          *ABTOLP/(PRTBTN*1.0D-3) )                             G0076450
ISN      170                     LCONV(JU)=U1DDIF.GT.ABTOLP                                       G0076460
ISN      171                     IF (LFRNT(JGRPJ)) CALL SUPROP(JGRPJ,52)                          G0076470
                 C                 I.E. CALL SUBROUTINE SUPROP(JGRPJ,LCTNPM)                      G0076480
ISN      173                     IF (IERR.NE.0) RETURN                                            G0076490
ISN      175                   END IF                                                             G0076500
ISN      176                 GO TO 810                                                            G0076510
                 CCC                                                                              G0076520
                 CCC            ADJUST THE FLOW RATE.                                             G0076530
                 C                                                                                G0076540
ISN      177         520     CONTINUE                                                             G0076550
ISN      178                 IF (COORTR) JFLOW=JHELJ                                              G0076560
ISN      180                 IF (.NOT.COORTR) JFLOW=JBNDSJ                                        G0076570
ISN      182                 IF (JCCALC) THEN                                                     G0076580
ISN      183                   BVFLMO=BVFLOW(JFLOW)                                               G0076590
ISN      184                   PRTBTN=FDELF*BVFLOW(JFLOW)                                         G0076600
ISN      185                   IF (PRTBTN.EQ.ZERO) PRTBTN=1.0D-8                                  G0076610
                 C                 DON'T FORGET -- BVFLOW(JFLOW) MAY BE NEGATIVE.                 G0076620
ISN      187                   BVFLOW(JFLOW)=BVFLOW(JFLOW)+PRTBTN                                 G0076630
ISN      188                   CALL ALDRVS(JGRPJ,JVAR,PRTBTN,ONE,.FALSE.,.FALSE.,                 G0076640
                1                          TEST  ,NGRPMX,NFPTMX,NNELMX,NBNDMX,NBLKMX,            G0076650
                2                          NDIRMX,NEDGMX,NCONMX,NUMAX ,NATRMX,NOMAX ,            G0076660
                3                          NMCS  ,NCOMPS,NVARS ,NBALNS,                          G0076670
                4                          ACCUMO,FLTMXO,FLTMYO,FLTMTO,                          G0076680
                5                          ENMCFO,VOLCFO,FLORHO,ACUMFO,FLOMO ,                   G0076690
                6                          GVCXMO,GVCXVO,GVCYMO,GVCYYO,                          G0076700
                7                          DXCFLO,DYCFLO,SPLITO,SRCETO,                          G0076710
                8                          FF2D0 ,COEFFS,LCONV ,REPEAT)                          G0076720
                 CCCCCCCCCCCCCCC              I.E. CALL ALDRVS(JGRPJ,JVAR,PRTBTN,SCALE,CALPRO,CALGRIG0076730
                 CCCCCCCCCCCCCCC                            ,TEST  ,NGRPMX,NFPTMX,NNELMX,NBNDMX,NBLKMX,G0076740
                 CCCCCCCCCCCCCCC                            NDIRMX,NEDGMX,NCONMX,NUMAX ,NATRMX,NOMAX ,G0076750
                 CCCCCCCCCCCCCCC                            NMCS  ,NCOMPS,NVARS ,NBALNS,              G0076760
                 CCCCCCCCCCCCCCC                            ACCUMO,FLTMXO,FLTMYO,FLTMTO,              G0076770
                 CCCCCCCCCCCCCCC                            ENMCFO,VOLCFO,FLORHO,ACUMFO,FLOMO ,       G0076780
                 CCCCCCCCCCCCCCC                            GVCXMO,GVCXVO,GVCYMO,GVCYYO,              G0076790
                 CCCCCCCCCCCCCCC                            DXCFLO,DYCFLO,SPLITO,SRCETO,              G0076800
                 C                                          FF2D0 ,COEFFS,LCONV ,REPEAT)              G0076810
ISN      189                   IF (IERR.NE.0) RETURN                                              G0076820
ISN      191                   BVFLOW(JFLOW)=BVFLMO                                               G0076830
ISN      192                 ELSE                                                                 G0076840
ISN      193                   BVFLOW(JFLOW)=BVFLOW(JFLOW)+U1D(JU)*FDAMP                          G0076850
                 C               U1DDIF=DABS(U1D(JU)/BVFLOW(JFLOW))  WAS REPLACED.                G0076860
                 C               LCONV(JU)=U1DDIF.GT.ABTOLF  HAS REPLACED.                        G0076870
ISN      194                     LCONV(JU)=.FALSE.                                                G0076880
                 C                 TEMPORARILY (1988/01/15), THERE IS NO CONTROL ON               G0076890
                 CCC               THE CONVERGENCE OF THE FLOW RATES.  IT IS ASSUMED              G0076900
                 CCC               THAT IF THE FLOW RATES REALLY DON'T CONVERGE,                  G0076910
                 CCC               THEN OTHER VARIABLES ALSO WON'T CONVERGE,                      G0076920
                 C                 AND WILL BE NOTICED BY THE CONVERGENCE CHECKER.                G0076930
ISN      195                   END IF                                                             G0076940
ISN      196                 GO TO 820                                                            G0076950
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                .    *....*...1.........2.........3.........4.........5.........6.........7.*.......8
                     C                                                                                 G0076960
                     C                  ADJUST THE TEMPERATURE.                                        G0076970
                     C                                                                                 G0076980
ISN     197            530       CONTINUE                                                             G0076990
ISN     198                      IF (JCCALC) THEN                                                     G0077000
ISN     199                         TO=T(JGRPJ)                                                       G0077010
ISN     200                         PRTBTN=DELTK                                                      G0077020
ISN     201                         T(JGRPJ)=T(JGRPJ)+PRTBTN                                          G0077030
ISN     202                         CALL ALDRVS(JGRPJ,JVAR,PRTBTN,ONE,.TRUE.,.FALSE.,                 G0077040
                                1                    TEST  ,NGRPMX,NFPTMX,NMELMX,NBNDMX,NBLKMX,       G0077050
                                2                    NDIRMX,NEDGMX,NCONMX,NUMAX ,NATRMX,NOMAX ,       G0077060
                                3                    NMCS  ,NCOMPS,NVARS ,NBALNS,                     G0077070
                                4                    ACCUMO,FLTMXO,FLTMYO,FLTMTO,                     G0077080
                                5                    EMMCFO,VOLCFO,FLORMO,ACUMFO,FLOMO ,              G0077090
                                6                    GVCXMO,GVCXVO,GVCYMO,GVCYVO,                     G0077100
                                7                    DXCFLO,DYCFLO,SPLITO,SRCETO,                     G0077110
                                8                    FF2DO ,COEFFS,LCONV ,REPEAT)                     G0077120
                     C                     I.E. CALL ALDRVS(JGRPJ,JVAR,PRTBTN,SCALE,CALPRO,CALGRI   G0077130
                     C                                 'TEST  ,NGRPMX,NFPTMX,NMELMX,NBNDMX,NBLKMX,    G0077140
                     C                                 NDIRMX,NEDGMX,NCONMX,NUMAX ,NATRMX,NOMAX ,     G0077150
                     C                                 NMCS  ,NCOMPS,NVARS ,NBALNS,                   G0077160
                     C                                 ACCUMO,FLTMXO,FLTMYO,FLTMTO,                   G0077170
                     C                                 EMMCFO,VOLCFO,FLORMO,ACUMFO,FLOMO ,            G0077180
                     C                                 GVCXMO,GVCXVO,GVCYMO,GVCYVO,                   G0077190
                     C                                 DXCFLO,DYCFLO,SPLITO,SRCETO,                   G0077200
                     C                                 FF2DO ,COEFFS,LCONV ,REPEAT)                   G0077210
ISN     203                         IF (IERR.NE.0) RETURN                                             G0077220
ISN     205                         T(JGRPJ)=TO                                                       G0077230
ISN     206                         CALL SUPROP(JGRPJ,53)                                             G0077240
                     C                     I.E. CALL SUBROUTINE SUPROP(JGRPJ,LCTMPN)                  G0077250
ISN     207                         IF (IERR.NE.0) RETURN                                             G0077260
ISN     209                        ELSE                                                               G0077270
ISN     210                         T(JGRPJ)=T(JGRPJ)+U1D(JU)*FDAMP                                   G0077280
ISN     211                         IF (LFICT) T(JGIMAG)=T(JGRPJ)                                     G0077290
ISN     213                         U1DDIF=DABS(U1D(JU))/(T(JGRPJ)+273.15D0)                          G0077300
                     C                     THIS ALLOWS THE TEMPERATURE TO BE BELOW 0 CELSIUS.        G0077310
ISN     214                         LCONV(JU)=U1DDIF.GT.ABTOLT                                        G0077320
ISN     215                        END IF                                                             G0077330
ISN     216                      GO TO 830                                                            G0077340
                     C                                                                                 G0077350
                     C                  ADJUST THE FRONT LOCATION FPDIST.                              G0077360
                     C                                                                                 G0077370
ISN     217            540       CONTINUE                                                             G0077380
ISN     218                      IF (JCCALC) THEN                                                     G0077390
ISN     219                         FPDSTO=FPDIST(JFPTJ)                                              G0077400
ISN     220                         PRTBTN=DELLC                                                      G0077410
ISN     221                         FPDIST(JFPTJ)=FPDIST(JFPTJ)+PRTBTN                                G0077420
ISN     222                         CALL ALDRVS(JGRPJ,JVAR,PRTBTN,ONE,.FALSE.,.TRUE.,                 G0077430
                                1                    TEST  ,NGRPMX,NFPTMX,NMELMX,NBNDMX,NBLKMX,       G0077440
                                2                    NDIRMX,NEDGMX,NCONMX,NUMAX ,NATRMX,NOMAX ,       G0077450
                                3                    NMCS  ,NCOMPS,NVARS ,NBALNS,                     G0077460
                                4                    ACCUMO,FLTMXO,FLTMYO,FLTMTO,                     G0077470
                                5                    EMMCFO,VOLCFO,FLORMO,ACUMFO,FLOMO ,              G0077480
                                6                    GVCXMO,GVCXVO,GVCYMO,GVCYVO,                     G0077490
                                7                    DXCFLO,DYCFLO,SPLITO,SRCETO,                     G0077500
                                8                    FF2DO ,COEFFS,LCONV ,REPEAT)                     G0077510
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                .    *....*...1.........2.........3.........4.........5.........6.........7.*.......8
                     C                     I.E. CALL ALDRVS(JGRPJ,JVAR,PRTBTN,SCALE,CALPRO,CALGRI   G0077520
                     C                                 'TEST  ,NGRPMX,NFPTMX,NMELMX,NBNDMX,NBLKMX,    G0077530
                     C                                 NDIRMX,NEDGMX,NCONMX,NUMAX ,NATRMX,NOMAX ,     G0077540
                     C                                 NMCS  ,NCOMPS,NVARS ,NBALNS,                   G0077550
                     C                                 ACCUMO,FLTMXO,FLTMYO,FLTMTO,                   G0077560
                     C                                 EMMCFO,VOLCFO,FLORMO,ACUMFO,FLOMO ,            G0077570
                     C                                 GVCXMO,GVCXVO,GVCYMO,GVCYVO,                   G0077580
                     C                                 DXCFLO,DYCFLO,SPLITO,SRCETO,                   G0077590
                     C                                 FF2DO ,COEFFS,LCONV ,REPEAT)                   G0077600
ISN     223                         IF (IERR.NE.0) RETURN                                             G0077610
ISN     225                         FPDIST(JFPTJ)=FPDSTO                                              G0077620
                     C                                                                                 G0077630
ISN     226                         CALL BLOKS1(NFPTMX,NGRPMX,FPDIST,                                 G0077640
                                1                FPDISX,FPDISY,FPDSNM,GPX,GPY)                          G0077650
                     C                     I.E. CALL BLOKS1(NFPTMX,NGRPMX,FPDIST,                    G0077660
                     C                                      FPDISX,FPDISY,FPDSNM,GPX,GPY)              G0077670
                     C                                                                                 G0077680
ISN     227                        ELSE                                                               G0077690
ISN     228                         FPDIST(JFPTJ)=FPDIST(JFPTJ)+U1D(JU)*FDAMP                         G0077700
                     C                     PERHAPS DX'S SHOULD BE CALCULATED HERE (QMARK)             G0077710
                     C                     FPDSNM IS CALCULATED IN BLOKS1.                            G0077720
ISN     229                         U1DDIF=DABS(U1D(JU))/FPDSNM(JFPTJ)                                G0077730
ISN     230                         LCONV(JU)=U1DDIF.GT.ABTOLL                                        G0077740
ISN     231                        END IF                                                             G0077750
ISN     232                      GO TO 840                                                            G0077760
                     C                                                                                 G0077770
                     C                  ADJUST THE FRONT LOCATION FRNDIS.                              G0077780
                     C                                                                                 G0077790
ISN     233            545       CONTINUE                                                             G0077800
ISN     234                      IFR=IOFGRP(JGRPJ)                                                    G0077810
ISN     235                      IF (LFICT) IIMAGE=IOFGRP(JGIMAG)                                     G0077820
                     C                     SCALVF=1.00-6*DT  HAS DELETED.                             G0077830
ISN     237                      IF (JCCALC) THEN                                                     G0077840
ISN     238                         FRNDSO=FRNDIS(IFR)                                                G0077850
ISN     239                         PRTBTN=DELLC                                                      G0077860
ISN     240                         FRNDIS(IFR)=FRNDIS(IFR)+PRTBTN                                    G0077870
ISN     241                         IF (LFICT) FRNDIS(IIMAGE)=FRNDIS(IFR)                             G0077880
ISN     243                         CALL ALDRVS(JGRPJ,JVAR,PRTBTN,SCALVF,.FALSE.,.TRUE.,              G0077890
                                1                    TEST  ,NGRPMX,NFPTMX,NMELMX,NBNDMX,NBLKMX,       G0077900
                                2                    NDIRMX,NEDGMX,NCONMX,NUMAX ,NATRMX,NOMAX ,       G0077910
                                3                    NMCS  ,NCOMPS,NVARS ,NBALNS,                     G0077920
                                4                    ACCUMO,FLTMXO,FLTMYO,FLTMTO,                     G0077930
                                5                    EMMCFO,VOLCFO,FLORMO,ACUMFO,FLOMO ,              G0077940
                                6                    GVCXMO,GVCXVO,GVCYMO,GVCYVO,                     G0077950
                                7                    DXCFLO,DYCFLO,SPLITO,SRCETO,                     G0077960
                                8                    FF2DO ,COEFFS,LCONV ,REPEAT)                     G0077970
                     C                     I.E. CALL ALDRVS(JGRPJ,JVAR,PRTBTN,SCALE,CALPRO,CALGRI   G0077980
                     C                                 'TEST  ,NGRPMX,NFPTMX,NMELMX,NBNDMX,NBLKMX,    G0077990
                     C                                 NDIRMX,NEDGMX,NCONMX,NUMAX ,NATRMX,NOMAX ,     G0078000
                     C                                 NMCS  ,NCOMPS,NVARS ,NBALNS,                   G0078010
                     C                                 ACCUMO,FLTMXO,FLTMYO,FLTMTO,                   G0078020
                     C                                 EMMCFO,VOLCFO,FLORMO,ACUMFO,FLOMO ,            G0078030
                     C                                 GVCXMO,GVCXVO,GVCYMO,GVCYVO,                   G0078040
                     C                                 DXCFLO,DYCFLO,SPLITO,SRCETO,                   G0078050
                     C                                 FF2DO ,COEFFS,LCONV ,REPEAT)                   G0078060
ISN     244                      IF (IERR.NE.0) RETURN                                                G0078070
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*....*...1.....2.....3.....4.....5.....6.....7.*.....8
ISN    246                FRNDIS(IFR)=FRNDSO                                          G0078080
ISN    247                IF (LFICT) FRNDIS(IIMAGE)=FRNDIS(IFR)                       G0078090
ISN    249                ISTART=IOFGRP(JADJAC(3,JGRPJ))                              G0078100
ISN    250              C OR ISTART=IFR-1; IF (ISTART.LT.1.AND..NOT.L2SYMH) ISTART=NOSG0078110
                        C                                                            G0078120
ISN    251              C OR IFINIS=IOFGRP(JADJAC(1,JGRPJ))                          G0078130
ISN    252                IF (LFICT) THEN                                           G0078140
ISN    253                  ISTART=MIN0(IFR,IIMAGE)                                 G0078150
ISN    254                  IFINIS=MAX0(IFR,IIMAGE)                                 G0078160
ISN    254                END IF                                                    G0078170
                        C                                                            G0078180
ISN    255                CALL CTFCFS(L2SYMH,IS,ART,IFINIS,NOS,NRS,NOMAX,NGRPMX,    G0078190
                                  1        DT,DCENDS,CENDIS,GX,GY,                   G0078200
                                  2        FRNDIS,OFRNDS,DFONTH,DFONTP,              G0078210
                                  3        DFRDTH,FRFRTH,VFDOTH,XIRING,YIRING,       G0078220
                                  4        GRAVP)                                    G0078230
                                  C     I.E. CALL CTFCFS(L2SYMH,JOSTA,JOFIN,NOS,NRS,NOMAX,NGRPMX,G0078240
                                  C                      DT,DCENDS,CENDIS,GX,GY,     G0078250
                                  C                      FRNDIS,OFRNDS,DFONTH,DFONTP,G0078260
                                  C                      DFRDTH,FRFRTH,VFDOTH,XIRING,YIRING,G0078270
                                  C                      GRAVP)                      G0078280
                                  C                                                  G0078290
ISN    256                ELSE                                                      G0078300
ISN    257                  FRNDIS(IFR)=FRNDIS(IFR)+SCALVF*U1D(JU)*FDAMP            G0078310
ISN    258                  IF (LFICT) FRNDIS(IIMAGE)=FRNDIS(IFR)                   G0078320
ISN    260                  U1DDIF=SCALVF*DABS(U1D(JU))/FRNDIS(IFR)                 G0078330
ISN    261                  LCONV(JU)=U1DDIF.GT.ABTOLL                              G0078340
ISN    262                END IF                                                    G0078350
ISN    263              GO TO 840                                                   G0078360
                        C                                                          G0078370
                        C     ADJUST THE VAPOUR-PHASE SATURATION.                  G0078380
ISN    264       550    CONTINUE                                                    G0078390
ISN    265              IF (JCCALC) THEN                                            G0078400
ISN    266                SGPO=SGP(JGRPJ)                                           G0078410
ISN    267                SOPO=SOP(JGRPJ)                                           G0078420
ISN    268                PRTBTN=DELSP                                              G0078430
ISN    269                SGP(JGRPJ)=SGP(JGRPJ)+PRTBTN                              G0078440
ISN    270                SOP(JGRPJ)=ONE-SGP(JGRPJ)-SWP(JGRPJ)                      G0078450
ISN    271                CALL ALDRVS(JGRPJ,JVAR,PRTBTN,ONE,.TRUE.,.FALSE.,         G0078460
                                  1        TEST  ,NGRPMX,NFPTMX,NWELMX,NBNDMX,NBLKMX,G0078470
                                  2        NDIRMX,NEDGMX,NCONMX,NUMAX ,NATRMX,NOMAX ,G0078480
                                  3        NHCS  ,NCOMPS,NVARS ,NBALNS,              G0078490
                                  4        ACCUMO,FLTHXO,FLTHYO,FLTHTO,              G0078500
                                  5        ENMCFO,VOLCFO,FLORHO,ACUMFO,FLOWO ,       G0078510
                                  6        GVCXHO,GVCXVO,GVCYHO,GVCYVO,              G0078520
                                  7        DXCFLO,DYCFLO,SPLITO,SRCETO,              G0078530
                                  8        FF2D0 ,COEFFS,LCONV ,REPEAT)              G0078540
                                  C     I.E. CALL ALDRVS(JGRPJ,JVAR,PRTBTN,SCALE,CALPRO,CALGRIG0078550
                                  C                      ,TEST  ,NGRPMX,NFPTMX,NWELMX,NBNDMX,NBLKMX,G0078560
                                  C                      NDIRMX,NEDGMX,NCONMX,NUMAX ,NATRMX,NOMAX ,G0078570
                                  C                      NHCS  ,NCOMPS,NVARS ,NBALNS,              G0078580
                                  C                      ACCUMO,FLTHXO,FLTHYO,FLTHTO,              G0078590
                                  C                      ENMCFO,VOLCFO,FLORHO,ACUMFO,FLOWO ,       G0078600
                                  C                      GVCXHO,GVCXVO,GVCYHO,GVCYVO,              G0078610
                                  C                      DXCFLO,DYCFLO,SPLITO,SRCETO,              G0078620
                                  C                      FF2D0 ,COEFFS,LCONV ,REPEAT)              G0078630
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*....*...1.....2.....3.....4.....5.....6.....7.*.....8
                        C                      FF2D0 ,COEFFS,LCONV ,REPEAT)          G0078640
ISN    272                IF (IERR.NE.0) RETURN                                     G0078650
ISN    274                SGP(JGRPJ)=SGPO                                           G0078660
ISN    275                SOP(JGRPJ)=SOPO                                           G0078670
ISN    276                CALL SUPROP(JGRPJ,55)                                     G0078680
                        C     I.E. CALL SUBROUTINE SUPROP(JGRPJ,LCTNPH)            G0078690
ISN    277                IF (IERR.NE.0) RETURN                                     G0078700
ISN    279              ELSE                                                        G0078710
ISN    280                IF ((.NOT.SWITB).AND.JGRPJ.EQ.4) THEN                     G0078720
ISN    281     48201        FORMAT(' DRAIN#1: DELTA SGP(4) WOULD HAVE BEEN',F13.9)  G0078730
ISN    282                  WRITE(6,48201)U1D(JU)                                   G0078740
ISN    283                  U1D(JU)=ZERO                                            G0078750
                        C        THIS IS A TEMPORARY (1985/11/29) FIX.             G0078760
ISN    284                END IF                                                    G0078770
ISN    285              DELSG=U1D(JU)                                               G0078780
ISN    286              IF (DELSG.GT. 0.05D0) DELSG= 0.05D0                         G0078790
ISN    288              IF (DELSG.LT.-0.05D0) DELSG=-0.05D0                         G0078800
ISN    290              SGP(JGRPJ)=SGP(JGRPJ)+DELSG*FDAMP                           G0078810
ISN    291              IF (LFICT) SGP(JGIMAG)=SGP(JGRPJ)                           G0078820
ISN    293              U1DDIF=DABS(U1D(JU))                                        G0078830
ISN    294              LCONV(JU)=U1DDIF.GT.ABTOLS                                  G0078840
ISN    295              IF (SGP(JGRPJ).LT.(SGIRR+1.00-10)) THEN                     G0078850
ISN    296                SGP(JGRPJ)=SGIRR                                          G0078860
ISN    297                IF (LFICT) SGP(JGIMAG)=SGP(JGRPJ)                         G0078870
ISN    299                IF (.NOT.COORTR) THEN                                     G0078880
ISN    300                  EQUIL(JGRPJ)=.FALSE.                                    G0078890
ISN    301                  IF (LFICT) EQUIL(JGIMAG)=EQUIL(JGRPJ)                   G0078900
ISN    303                END IF                                                    G0078910
ISN    304                LCONV(JU)=.TRUE.                                          G0078920
ISN    305              END IF                                                      G0078930
ISN    306            END IF                                                        G0078940
ISN    307            GO TO 850                                                     G0078950
                      C                                                            G0078960
                      C     ADJUST THE LIQUID-WATER-PHASE SATURATION.              G0078970
ISN    308     560    CONTINUE                                                      G0078980
ISN    309            IF (JCCALC) THEN                                              G0078990
ISN    310              SWPO=SWP(JGRPJ)                                             G0079000
ISN    311              SOPO=SOP(JGRPJ)                                             G0079010
ISN    312              PRTBTN=DELSP                                                G0079020
ISN    313              SWP(JGRPJ)=SWP(JGRPJ)+PRTBTN                                G0079030
ISN    314              SOP(JGRPJ)=ONE-SGP(JGRPJ)-SWP(JGRPJ)                        G0079040
ISN    315              CALL ALDRVS(JGRPJ,JVAR,PRTBTN,ONE,.TRUE.,.FALSE.,           G0079050
                                  1        TEST  ,NGRPMX,NFPTMX,NWELMX,NBNDMX,NBLKMX,G0079060
                                  2        NDIRMX,NEDGMX,NCONMX,NUMAX ,NATRMX,NOMAX ,G0079070
                                  3        NHCS  ,NCOMPS,NVARS ,NBALNS,              G0079080
                                  4        ACCUMO,FLTHXO,FLTHYO,FLTHTO,              G0079090
                                  5        ENMCFO,VOLCFO,FLORHO,ACUMFO,FLOWO ,       G0079100
                                  6        GVCXHO,GVCXVO,GVCYHO,GVCYVO,              G0079110
                                  7        DXCFLO,DYCFLO,SPLITO,SRCETO,              G0079120
                                  8        FF2D0 ,COEFFS,LCONV ,REPEAT)              G0079130
                                  C     I.E. CALL ALDRVS(JGRPJ,JVAR,PRTBTN,SCALE,CALPRO,CALGRIG0079140
                                  C                      ,TEST  ,NGRPMX,NFPTMX,NWELMX,NBNDMX,NBLKMX,G0079150
                                  C                      NDIRMX,NEDGMX,NCONMX,NUMAX ,NATRMX,NOMAX ,G0079160
                                  C                      NHCS  ,NCOMPS,NVARS ,NBALNS,              G0079170
                                  C                      ACCUMO,FLTHXO,FLTHYO,FLTHTO,              G0079180
                                  C                                                                G0079190
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                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
                C                              ENHCFO,VOLCFO,FLORHO,ACUMFO,FLOMO ,      G0079200
                C                              GVCXHO,GVCXVO,GVCYHO,GVCYVO,             G0079210
                C                              DXCFLO,DYCFLO,SPLITO,SRCETO,             G0079220
                C                              FF2D0 ,COEFFS,LCONV ,REPEAT)             G0079230
ISN      316                  IF (IERR.NE.0) RETURN                                     G0079240
ISN      318                  SWP(JGRPJ)=SWPO                                           G0079250
ISN      319                  SOP(JGRPJ)=SOPO                                           G0079260
ISN      320                  CALL SUPROP(JGRPJ,56)                                     G0079270
                C                    I.E. CALL SUBROUTINE SUPROP(JGRPJ,LCTNPM)         G0079280
ISN      321                  IF (IERR.NE.0) RETURN                                     G0079290
ISN      323                 ELSE                                                       G0079300
ISN      324                  IF ((.NOT.SWIT8).AND.JGRPJ.EQ.4) THEN                     G0079310
ISN      325  48202             FORMAT(' DRAIN#1: DELTA SWP(4) WOULD HAVE BEEN',F13.9) G0079320
ISN      326                     WRITE(6,48202)U1D(JU)                                  G0079330
ISN      327                     U1D(JU)=ZERO                                           G0079340
                C                    THIS IS A TEMPORARY (1985/11/29) FIX.             G0079350
ISN      328                   END IF                                                   G0079360
ISN      329                  DELSW=U1D(JU)                                             G0079370
ISN      330                  IF (DELSW.GT. 0.05D0) DELSW= 0.05D0                       G0079380
ISN      332                  IF (DELSW.LT.-0.05D0) DELSW=-0.05D0                       G0079390
ISN      334                  SWPOLD=SWP(JGRPJ)                                         G0079400
ISN      335                  SWP(JGRPJ)=SWP(JGRPJ)+DELSW*FDAMP                         G0079410
ISN      336                  IF (LFICT) SWP(JGIMAG)=SWP(JGRPJ)                         G0079420
                C                    QUICK FIX: DON'T USE NEWTON'S METHOD              G0079430
                C                         IF OVERSHOOT OCCURS.                         G0079440
ISN      338                  DRYKM0=SWP(JGRPJ).LT.SMC                                  G0079450
ISN      339                  DRYKM1=SWPOLD.LT.SMC                                      G0079460
ISN      340                  OVERSH=(DRYKM0.AND..NOT.DRYKM1)                           G0079470
                1                    .OR.(DRYKM1.AND..NOT.DRYKM0)                      G0079480
ISN      341                  IF (OVERSH) THEN                                          G0079490
ISN      342                     SWP(JGRPJ)=0.5D0*(SWP(JGRPJ)+SWPOLD)                   G0079500
ISN      343                     IF (LFICT) SWP(JGIMAG)=SWP(JGRPJ)                      G0079510
ISN      345                     VOUCSC=.TRUE.                                          G0079520
ISN      346                   END IF                                                   G0079530
ISN      347                  U1DDIF=DABS(U1D(JU))                                      G0079540
ISN      348                  IF (LFRNT(JGRPJ).AND.SWP(JGRPJ).LT.SMC) THEN              G0079550
ISN      349                     SWP(JGRPJ)=SMC                                         G0079560
ISN      350                     IF (LFICT) SWP(JGIMAG)=SWP(JGRPJ)                      G0079570
ISN      352                     U1DDIF=DABS(SWPOLD-SWP(JGRPJ))                         G0079580
ISN      353                   END IF                                                   G0079590
                C                    THIS IS A SEMI-PERMANENT (1986/03/13) FIX.        G0079600
                C                    ALSO SEE THE SEMI-PERM. FIX AT MAIN, LINES 407.3/407.9G0079610
ISN      354                  LCONV(JU)=U1DDIF.GT.ABTOLS                                G0079620
ISN      355                 END IF                                                     G0079630
ISN      356                GO TO 860                                                   G0079640
                C                                                                       G0079650
                C                    ADJUST LIQUID-OIL MOLE FRACTION #IC.               G0079660
                C                                                                       G0079670
ISN      357      570       CONTINUE                                                    G0079680
ISN      358                IC=JVAR-1                                                   G0079690
ISN      359                IF (JCCALC) THEN                                            G0079700
ISN      360                   XIO=XMOLE( IC ,JGRPJ)                                    G0079710
ISN      361                   XCO=XMOLE(NHCS,JGRPJ)                                    G0079720
                C                  TO =T(JGRPJ) HAS DELETED.                            G0079730
ISN      362                   PRTBTN=DELXI                                             G0079740
ISN      363                   XMOLE( IC ,JGRPJ)=XMOLE( IC ,JGRPJ)+PRTBTN               G0079750
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                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
ISN      364                   XMOLE(NHCS,JGRPJ)=XMOLE(NHCS,JGRPJ)-PRTBTN               G0079760
                C                                                                       G0079770
                C                    THE CALL TO VPTEMP (ALIAS TEMPS) HAS BEEN DELETED. G0079780
                C                                                                       G0079790
ISN      365                   CALL ALDRVS(JGRPJ,JVAR,PRTBTN,ONE,.TRUE.,.FALSE.,      G0079800
                1                         TEST  ,NGRPMX,NFPTMX,NWELMX,NBNDMX,NBLKMX,   G0079810
                2                         NDIRMX,NEDGMX,NCONMX,NUMAX ,NATRMX,NOMAX ,   G0079820
                3                         NHCS  ,NCOMPS,NVARS ,NBALNS,                 G0079830
                4                         ACCUMO,FLTMXO,FLTMYO,FLTMTO,                 G0079840
                5                         ENHCFO,VOLCFO,FLORHO,ACUMFO,FLOMO ,          G0079850
                6                         GVCXHO,GVCXVO,GVCYHO,GVCYVO,                 G0079860
                7                         DXCFLO,DYCFLO,SPLITO,SRCETO,                 G0079870
                8                         FF2D0 ,COEFFS,LCONV ,REPEAT)                 G0079880
                C                    I.E. CALL ALDRVS(JGRPJ,JVAR,PRTBTN,SCALE,CALPRO,CALGRIG0079890
                C                           ,TEST  ,NGRPMX,NFPTMX,NWELMX,NBNDMX,NBLKMX,  G0079900
                C                           NDIRMX,NEDGMX,NCONMX,NUMAX ,NATRMX,NOMAX ,   G0079910
                C                           NHCS  ,NCOMPS,NVARS ,NBALNS,                 G0079920
                C                           ACCUMO,FLTMXO,FLTMYO,FLTMTO,                 G0079930
                C                           ENHCFO,VOLCFO,FLORHO,ACUMFO,FLOMO ,          G0079940
                C                           GVCXHO,GVCXVO,GVCYHO,GVCYVO,                 G0079950
                C                           DXCFLO,DYCFLO,SPLITO,SRCETO,                 G0079960
                C                           FF2D0 ,COEFFS,LCONV ,REPEAT)                 G0079970
ISN      366                   IF (IERR.NE.0) RETURN                                    G0079980
ISN      368                   XMOLE( IC ,JGRPJ)=XIO                                    G0079990
ISN      369                   XMOLE(NHCS,JGRPJ)=XCO                                    G0080000
                C                  T(JGRPJ)=TO HAS DELETED.                             G0080010
ISN      370                   CALL SUPROP(JGRPJ,57)                                    G0080020
                C                    I.E. CALL SUBROUTINE SUPROP(JGRPJ,LCTNPM)         G0080030
ISN      371                   IF (IERR.NE.0) RETURN                                    G0080040
ISN      373                  ELSE                                                      G0080050
ISN      374                   DELXM=U1D(JU)                                            G0080060
ISN      376                   IF (DELXM.GT. 0.05D0) DELXM= 0.05D0                      G0080070
ISN      377                   IF (DELXM.LT.-0.05D0) DELXM=-0.05D0                      G0080080
ISN      379                   XMOLE(IC,JGRPJ)=XMOLE(IC,JGRPJ)+DELXM*FDAMP              G0080090
ISN      380                   IF (LFICT) XMOLE(IC,JGIMAG)=XMOLE(IC,JGRPJ)              G0080100
                C                    WHEN JCCALC IS FALSE, IT IS NOT NECESSARY TO CALL  G0080110
                C                    PROPTY UNTIL EVERY UNKNOWN HAS BEEN ADJUSTED.      G0080120
ISN      382                   U1DDIF=DABS(U1D(JU))                                     G0080130
ISN      383                   LCONV(JU)=U1DDIF.GT.ABTOLX                               G0080140
ISN      384                 END IF                                                     G0080150
ISN      385                GO TO 870                                                   G0080160
                C                                                                       G0080170
                C                    ADJUST NOTHING, PREPARE A FILLER COLUMN IN COEFFS. G0080180
                C                                                                       G0080190
ISN      386      580       CONTINUE                                                    G0080200
ISN      387                IF (JCCALC) THEN                                            G0080210
ISN      388                   JCOSTA=J1CONX(JGRPJ)                                     G0080220
ISN      389                   JCOFIN=J1CONX(JGRPJ+1)-1                                 G0080230
ISN      390                   DO 584 JCONXJ=JCOSTA,JCOFIN,1                            G0080240
ISN      391                     DO 582 JEQN=1,NVARS                                    G0080250
ISN      392                       COEFFS(JEQN,JVAR,JCONXJ)=ZERO                        G0080260
ISN      393      582            CONTINUE                                               G0080270
ISN      394      584           CONTINUE                                                G0080280
ISN      395                    JCONXJ=JCONX(JBDIAG+0-0,JGRPJ)                          G0080290
ISN      396                    COEFFS(JVAR,JVAR,JCONXJ)=ONE                            G0080300
ISN      397                  END IF                                                    G0080310
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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
                C
                C              IF JCCALC IS FALSE, THEN DO NOTHING.                                  G0080320
                C                                                                                    G0080330
ISN      398                   GO TO 880                                                             G0080340
                C                                                                                    G0080350
ISN      399          810      CONTINUE                                                              G0080360
ISN      400          820      CONTINUE                                                              G0080370
ISN      401          830      CONTINUE                                                              G0080380
ISN      402          840      CONTINUE                                                              G0080390
ISN      403          850      CONTINUE                                                              G0080400
ISN      404          860      CONTINUE                                                              G0080410
ISN      405          870      CONTINUE                                                              G0080420
ISN      406          880      CONTINUE                                                              G0080430
ISN      407          940    CONTINUE                                                                G0080440
ISN      408          950  CONTINUE                                                                  G0080450
                C                                                                                    G0080460
                CCC         MAKE THE REST OF THE VARIABLES CONSISTENT.                               G0080470
ISN      409              DO 960 JGRPJ=1,NGRPS                                                       G0080480
ISN      410                 SOP(JGRPJ)=ONE-SGP(JGRPJ)-SWP(JGRPJ)                                   G0080490
ISN      411                 IF (LFRNT(JGRPJ).AND.IFORML.EQ.1) THEN                                 G0080500
ISN      412                    SOIRRW=0.211D0                                                      G0080510
                C                     THIS IS A TEMPORARY (1985/11/06) FIX.                          G0080520
ISN      413                    IF (SOP(JGRPJ).LT.SOIRRW) THEN                                      G0080530
ISN      414                       SOP(JGRPJ)=SOIRRW+4.0D-3                                         G0080540
ISN      415                       SWP(JGRPJ)=ONE-SOP(JGRPJ)-SGP(JGRPJ)                             G0080550
ISN      416                    SOP(JGRPJ)=ONE-SGP(JGRPJ)-SWP(JGRPJ)                                G0080560
                CCC                   THE PURPOSE OF THE ABOVE STATEMENT IS TO MAINTAIN             G0080570
                CCC                   CONSISTENCY, IN THE LEAST SIGNIFICANT BITS OF THE             G0080580
ISN      417          C               SATURATIONS, WITH OTHER PARTS OF THE PROGRAM.                  G0080590
ISN      418                    END IF                                                              G0080600
ISN      420                 IF (XMOLE(1,JGRPJ).GT.0.8D0) XMOLE(1,JGRPJ)=0.8D0                      G0080610
ISN      421              END IF                                                                     G0080620
ISN      422              XMOLEC=ONE                                                                 G0080630
ISN      423              NHCSM1=NHCS-1                                                              G0080640
ISN      424              DO 955 IC=1,NHCSM1                                                         G0080650
ISN      425                 XMOLEC=XMOLEC-XMOLE(IC,JGRPJ)                                           G0080660
ISN      426          955 CONTINUE                                                                   G0080670
                C            XMOLE(NHCS,JGRPJ)=XMOLEC                                              G0080680
                CCC                                                                                  G0080690
                CCC         THE CALL TO VPTEMP (ALIAS TEMPS) HAS BEEN DELETED.                       G0080700
                CCC                                                                                  G0080710
                CCC         IF JGRPJ IS A FRONT POINT, EQUIL IS TRUE AUTOMATICALLY.                  G0080720
                C           THE ABOVE COMMENT IS NOT AS RELEVANT AS IT USED TO BE.                   G0080730
ISN      427      960 CONTINUE                                                                       G0080740
                C                                                                                    G0080750
ISN      428          CALL PROPTY(1,NGRPS,49,-1)                                                     G0080760
                C          ;I.E. CALL SUBROUTINE PROPTY(ISTART,IFINIS,LCTNPM,IJOB)                   G0080770
ISN      429          IF (IERR.NE.0) RETURN                                                          G0080780
                C                                                                                    G0080790
ISN      431          IF (.NOT.JCCALC) THEN                                                          G0080800
                CCC                                                                                  G0080810
                CCC         CALCULATE REPEAT, AND PRINT OUT LCONV.                                   G0080820
ISN      432            REPEAT=.FALSE.                                                             G0080830
ISN      433            DO 965 JU=1,NUS                                                            G0080840
ISN      434               REPEAT=REPEAT.OR.LCONV(JU)                                              G0080850
                                                                                                     G0080860
                                                                                                     G0080870
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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
ISN      435          965    CONTINUE                                                               G0080880
ISN      436          968    FORMAT(' CONV AL',I1,':',18(1X,5L1))                                   G0080890
ISN      437                 LNSIZE=90                                                              G0080900
ISN      438                 NLINES=(NUS/LNSIZE)+1                                                  G0080910
ISN      439                 DO 970 ILINE=1,NLINES                                                  G0080920
ISN      440                    JUSTA=(ILINE-1)*LNSIZE+1                                            G0080930
ISN      441                    JUEND=MIN0(ILINE*LNSIZE,NUS)                                        G0080940
ISN      442                    WRITE(6,968)ILINE,(LCONV(JU),JU=JUSTA,JUEND)                        G0080950
ISN      443          970    CONTINUE                                                               G0080960
ISN      444              END IF                                                                     G0080970
                C                                                                                    G0080980
ISN      445              IF (SWIT3) GO TO 47906                                                     G0080990
ISN      446              ICHECK=6                                                                   G0081000
ISN      447              CPUNEW=UTTIMR(1)                                                           G0081010
ISN      448              CPUINC=CPUNEW-CPUOLD                                                       G0081020
ISN      449              DELCPU(ICHECK)=CPUINC                                                      G0081030
ISN      450              CPUOLD=CPUNEW                                                              G0081040
ISN      451              WRITE(6,47990)ICHECK,CPUNEW,CPUINC                                         G0081050
ISN      452              DELCPU(ICHECK)=CPUINC                                                      G0081060
ISN      453          47906 CONTINUE                                                                 G0081070
ISN      454          47990 FORMAT(' AT CHECKPOINT ',I2,'  THE TOTAL TIME IS ',F8.4,               G0081080
                     1    ' SEC. WITH ',F7.4,' SEC. SINCE THE PREVIOUS CHECKPOINT.')               G0081090
                C                                                                                    G0081100
                C            CHECK IF FPOIST'S ARE IN RANGE (QMARK)                                  G0081110
                C            CALL BLOCKS IF NOT ALL ARE IN RANGE (QMARK)                             G0081120
ISN      455              RETURN                                                                     G0081130
ISN      456              END                                                                        G0081140
                                                                                                     G0081150
*STATISTICS*   SOURCE STATEMENTS = 412, PROGRAM SIZE = 21036 BYTES, PROGRAM NAME = ALAJST    PAGE:  155.

*STATISTICS*    NO DIAGNOSTICS GENERATED.

**ALAJST** END OF COMPILATION 32 ******
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OPTIONS IN EFFECT:  NOLIST NOMAP NOXREF NOGOSTMT NODECK   SOURCE   TERM NOOBJECT FIXED  NOTEST   TRMFLG   SRCFLG
                    NOSYM NORENT   SDUMP AUTODBL(NONE)   NOSXM    IL
                      OPT(0) LANGLVL(77) NOFIPS   FLAG(I)  NAME(MAIN  ) LINECOUNT(60)      CHARLEN(500)

                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
                C.ALDRVS                                                                        GOOD1160
                C                                                                               GOOD1170
                C  SOO.  COMPUTE ONE COLUMN OF THE JACOBIAN.                                    GOOD1180
                C                                                                               GOOD1190
ISN         1         SUBROUTINE ALDRVS(JGRPJ,JVAR,PRTBTN,SCALE,CALPRO,CALGRI,                GOOD1200
                   1                  TEST  ,NGRPMX,NFPTMX,NWELMX,NBNDMX,NBLKMX,            GOOD1210
                   2                  NDIRMX,NEDGMX,NCONMX,NUMAX ,NATRMX,NOMAX ,            GOOD1220
                   3                  NHCS  ,NCOMPS,NVARS ,NBALNS,                          GOOD1230
                   4                  ACCUMO,FLTMXO,FLTMYO,FLTMTO,                          GOOD1240
                   5                  ENHCFO,VOLCFO,FLORHO,ACUMFO,FLOMO ,                   GOOD1250
                   6                  GVCXHO,GVCXVO,GVCYHO,GVCYVO,                          GOOD1260
                   7                  DXCFLO,DYCFLO,SPLITO,SRCETO,                          GOOD1270
                   8                  FF2DO ,COEFFS,LCONV ,REPEAT)                          GOOD1280
                C       TEMPORARY NOTE: ALSOLV MUST BE REVISED TO ALLOW FOR THE FACT        GOOD1290
                C       THAT THE CONNECTIONS ARE NOW COLUMN-ORIENTED, AND ALSO THAT         GOOD1300
                C       THE FIRST TWO SUBSCRIPTS ARE SWITCHED.  (DONE?)                     GOOD1310
ISN         2         IMPLICIT DOUBLE PRECISION (A-H,K,O-Z)                                 GOOD1320
                C                                                                           GOOD1330
ISN         3         INTEGER GRPLIS(55)                                                    GOOD1340
ISN         4         INTEGER FPTLIS(16)                                                    GOOD1350
ISN         5         LOGICAL FPTMOD(16)                                                    GOOD1360
ISN         6         DOUBLE PRECISION DUMMY1(05,55),DUMMY2(05,55),DUMMY3(5,16)             GOOD1370
ISN         7         DOUBLE PRECISION DFF2D(5),DUMMY4(275)                                 GOOD1380
ISN         8         DOUBLE PRECISION ACCUM(10,55),ACCUMO(NBALNS,NGRPMX)                   GOOD1390
ISN         9         DOUBLE PRECISION ACUMF(10,16),ACUMFO(NBALNS,NFPTMX)                   GOOD1400
ISN        10         DOUBLE PRECISION FLOM(10,150),FLOMO(NBALNS,NEDGMX)                    GOOD1410
ISN        11         DOUBLE PRECISION FLORH(2,150),FLORHO(   2  ,NEDGMX)                   GOOD1420
ISN        12         DOUBLE PRECISION ENHCF(05,55),ENHCFO(NCOMPS,NGRPMX),DENHCF(4)         GOOD1430
ISN        13         DOUBLE PRECISION VOLCF(05,55),VOLCFO(NCOMPS,NGRPMX),DVOLCF(4)         GOOD1440
ISN        14         DOUBLE PRECISION FF2D(5,55),FF2DO(NVARS,NGRPMX)                       GOOD1450
ISN        15         DOUBLE PRECISION FLPSUM(10,55),CHFSUM(10,55)                          GOOD1460
ISN        16         DOUBLE PRECISION CFLOCB( 5,55),CFLOCF( 5,55)                          GOOD1470
ISN        17         DOUBLE PRECISION CHANGE(10),CHANGF(10)                                GOOD1480
ISN        18         DOUBLE PRECISION COEFFS(NVARS,NVARS,NCONMX)                           GOOD1490
ISN        19         LOGICAL CALPRO,CALGRI,TEST,OUTP,LPTRB,LFRGP,REPEAT,LCONV(NUMAX)       GOOD1500
ISN        20         LOGICAL DUMMY5,DUMMY6(275)                                            GOOD1510
ISN        21         CHARACTER*6 EQCD                                                      GOOD1520
ISN        22         DOUBLE PRECISION FLTMXA(10,150),FLTMXO(NBALNS,NEDGMX)                 GOOD1530
ISN        23         DOUBLE PRECISION FLTMYA(10,150),FLTMYO(NBALNS,NEDGMX)                 GOOD1540
ISN        24         DOUBLE PRECISION FLTMTA(10,150),FLTMTO(NBALNS,NEDGMX)                 GOOD1550
ISN        25         DOUBLE PRECISION GVCXH(55),GVCXHO(NGRPMX)                             GOOD1560
ISN        26         DOUBLE PRECISION GVCXV(55),GVCXVO(NGRPMX)                             GOOD1570
ISN        27         DOUBLE PRECISION GVCYH(55),GVCYHO(NGRPMX)                             GOOD1580
ISN        28         DOUBLE PRECISION GVCYV(55),GVCYVO(NGRPMX)                             GOOD1590
ISN        29         DOUBLE PRECISION DXCFL(10),DXCFLO(NBALNS)                             GOOD1600
ISN        30         DOUBLE PRECISION DYCFL(10),DYCFLO(NBALNS)                             GOOD1610
ISN        31         DOUBLE PRECISION SPLIT(8,11),SPLITO(NDIRMX,NWELMX)                    GOOD1620
ISN        32         DOUBLE PRECISION SRCETM(10,8,11),SRCETO(NBALNS,NDIRMX,NWELMX)         GOOD1630
ISN        33         INTEGER GR1LIS(55),GR2LIS(55),GR3LIS(55),EDGLIS(150)                  GOOD1640
ISN        34         INTEGER JADJV(4),JCXLIL(55)                                           GOOD1650
ISN        35         LOGICAL LG1CLC(55),LG2CLC(55),LG3CLC(55),LEDCLC(150)                  GOOD1660
ISN        36         LOGICAL LFICT,LCHNG1,LCHNG2,LCALC                                     GOOD1670
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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
ISN        37         DOUBLE PRECISION FTMXCM(10,36),FTMYCM(10,36)                          GOOD1680
ISN        38         DOUBLE PRECISION DFTMT1,DFTMT2,DFTMX(10),DFTMY(10)                    GOOD1690
ISN        39         DOUBLE PRECISION CFX(4),CFY(4),DCFX(4),DCFY(4)                        GOOD1700
ISN        40         DOUBLE PRECISION DFLSUM(10),DFLOM(10),DACCUM(10),DSRCET(10)           GOOD1710
                C                                                                           GOOD1720
ISN        41         LOGICAL COORTR,TRACKF,OVTAKE,DATAFR,RESTRT                            GOOD1730
ISN        42         DOUBLE PRECISION LAMBDA                                               GOOD1740
ISN        43         LOGICAL SWIT1,SWIT2,SWIT3,SWIT4,SWIT5,SWIT6,SWIT7,SWIT8               GOOD1750
ISN        44         INTEGER FPJX,FPJY                                                     GOOD1760
ISN        45         LOGICAL LFRNT                                                         GOOD1770
ISN        46         LOGICAL BLSPEC                                                        GOOD1780
ISN        47         INTEGER EDSIGN                                                        GOOD1790
ISN        48         LOGICAL FREDGE,LBNDED,LNULED                                          GOOD1800
ISN        49         CHARACTER*4 CYLN,SPHR,CSYSTM                                          GOOD1810
ISN        50         LOGICAL L2SYMM,LCIRCL                                                 GOOD1820
ISN        51         CHARACTER*6 TRANSP,MATCHC,BOTH,NEITHR,EQTYPE                          GOOD1830
ISN        52         CHARACTER*4 CENT,FRNT,FRNO,BOUN,AXIS,INTR,EDTYPE                      GOOD1840
                C                                                                           GOOD1850
ISN        53         COMMON/PRNBLK/SMC,SOIRR,SGIRR,SGPDUM,SMPDUM,KRGDUM,KROG,KRON,         GOOD1860
                   1               KRNDUM,KRODUM,KRGSGD,KROGSG,KRONSM,KRNSMD,KROSGD,     GOOD1870
                   2               KROSMD,PCHDUM,PCVDUM,                                 GOOD1880
                   3               LCTN,IERR,IWRONG                                      GOOD1890
ISN        54         COMMON/GRIPRO/DT,DXFRNT,DISXN,DX(57),DISTX(58),NFRONT,NBLOKS,         GOOD1900
                   1               NG,NJAY,COORTR,TRACKF,OVTAKE,DATAFR,RESTRT            GOOD1910
ISN        55         COMMON/STATEV/SNP(55),SGP(55),SOP(55),T(55),P(55),                    GOOD1920
                   1               XMOLE(3,55),XO(55),XSOL(55),XN(55)                    GOOD1930
ISN        56         COMMON/FLUPRO/DMP(55),DOP(55),DGP(55),UMP(55),UOP(55),UGP(55),        GOOD1940
                   1               CMP(55),COP(55),CGP(55),KO(55),KSOL(55),LAMBDA(55),   GOOD1950
                   2               DENSOL(55),DENSOH(55),DENSOS(55),                     GOOD1960
                   3               DFSPCH(55),DFSPCO(55),DFSPCV(55),GASCON               GOOD1970
ISN        57         COMMON/SWIT   /SWIT1,SWIT2,SWIT3,SWIT4,SWIT5,SWIT6,SWIT7,SWIT8        GOOD1980
ISN        58         COMMON/BASICS/ZERO,HALF,ONE,TWO                                       GOOD1990
ISN        59         COMMON/IBASCS/NULL                                                    GOOD2000
ISN        60         COMMON/DIMENS/NDIMNS,NX,NY,NOS,NRS,NRFM,NRFP                          GOOD2010
ISN        61         COMMON/FRONT1/NFPTOT,FPJX(16),FPJY(16)                                GOOD2020
ISN        62         COMMON/FRONT3/FPDIST(16),FPDISX(16),FPDISY(16),FPDSNM(16)             GOOD2030
ISN        63         COMMON/TABLS1/NBLKS,NGRPS,JGRPOG(50),JAGPOF(9,16),                    GOOD2040
                   1               JBLK(55),JFPT(55)                                     GOOD2050
ISN        64         COMMON/TABL1A/LFRNT(55)                                               GOOD2060
ISN        65         COMMON/BVOLFL/BVFLOW(28),FLFR(150)                                    GOOD2070
ISN        66         COMMON/GRAVTY/GX,GY,DENMSN(55),DENMSO(55),DENMSV(55),GRAVP(55)        GOOD2080
ISN        67         COMMON/YALCO1/NUS,NCONXS,JBDIAG,JICONX(55),NNEIBS(55),                GOOD2090
                   1               JGRPOC(715),JNEIBR(715)                               GOOD2100
ISN        68         COMMON/YALCO2/NBANMX,JCONX(73,55)                                     GOOD2110
ISN        69         COMMON/CBCORX/BLCORX(8,50)                                            GOOD2120
ISN        70         COMMON/CBCORY/BLCORY(8,50)                                            GOOD2130
ISN        71         COMMON/CBSPEC/BLSPEC(8,50)                                            GOOD2140
ISN        72         COMMON/CBAREA/BLAREA(50),OBAREA(50)                                   GOOD2150
ISN        73         COMMON/GPXY   /GPX(55),GPY(55)                                        GOOD2160
ISN        74         COMMON/EDSMAL/NDIRS,NEDGES,EDSIGN(8)                                  GOOD2170
ISN        75         COMMON/EDLOGC/FREDGE(150),LBNDED(150),LNULED(150)                     GOOD2180
ISN        76         COMMON/EDTOE2/JGRPOE(6,150),JDIROE(2,150)                             GOOD2190
ISN        77         COMMON/EDTOG /JEDGOG(8,55)                                            GOOD2200
ISN        78         COMMON/EDTOF /JEDGOF(2,16),JPEDMO(16),JPEDVE(16)                      GOOD2210
ISN        79         COMMON/YALED1/JIEFEC(55),NIEDGS(55),                                  GOOD2220
                   1               JIGRUP(825),JIEDGE(825)                               GOOD2230
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                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
ISN      80           COMMON/EDLOCT/EDSTAX(150),EDSTAY(150),EDFINX(150),EDFINY(150)      G0082240
ISN      81           COMMON/SCALES/SCALEP,SCALEH,SCALEV,SCALVF                          G0082250
ISN      82           COMMON/ADJACN/IFORML,JUPGRP(16),JADJAC(4,55)                       G0082260
ISN      83           COMMON/OFFSET/JOFSMN,JOFSMX                                        G0082270
ISN      84           COMMON/IBCONS/IHEQN,IHBAL,IVEQN,IVBAL                              G0082280
ISN      85           COMMON/CORSYS/CYLN,SPHR,CSYSTM                                     G0082290
ISN      86           COMMON/LOGSYM/L2SYMM,LCIRCL                                        G0082300
ISN      87           COMMON/EQNTYP/TRANSP,MATCHC,BOTH,NEITHR,EQTYPE(10,3)               G0082310
ISN      88           COMMON/EDGTYP/CENT,FRNI,FRNO,BOUN,AXIS,INTR,EDTYPE(150)            G0082320
ISN      89           COMMON/EQNTCD/IEQCOD(10,55)                                        G0082330
ISN      90           COMMON/IJTBIJ/IOFGRP(55),JOFGRP(55),JGRPIJ(36,24)                  G0082340
ISN      91           COMMON/TABLS2/NRLGS,JGRPOF(16),JRLG(55),JGRPOR(54),
                     1             JGPTNR(55),JTYFRN(55),JTYRFL(55),JRF(IM(55)
ISN      92           COMMON/DGRID /DTMTAM(36),DTMTAP(36),DOPHMH(36),DTHETA(36),
                     1             DFONTM(36),DFONTP(36),
                     2             DRPHMH(24),DRADM1(24),DRADP1(24)                   G0082380
ISN      93           COMMON/FRNTCF/DCENDS,CENDIS,FRNDIS(36),DFRDTH(36),FRFRTH(36),
                     1             VFDOTN(36),XIRING(36),YIRING(36)                   G0082400
ISN      94           COMMON/OFRNCF/OFRNDS(36)                                         G0082410
ISN      95           COMMON/HELLJ1/NHELLS,IENTNO(11),IENTNR(11),JGNEAR(11),
                     1             JHELOC(55)                                         G0082430
ISN      96           COMMON/HELLJ2/JGPSC(8,11)                                        G0082440
                C                                                                     G0082450
                C    PAGE 1A                                                          G0082460
                C     INPUT SCALARS: NVARS,JOFSMX,JOFSMN,L2SYMM,CALPRO,JGRPJ,CALGRI,  G0082470
                C                    NOS,NOMAX,DT,DCENDS                              G0082480
                C     INPUT  ARRAYS: JTYRFL,JRFLIM,IOFGRP,JADJAC,FRNDIS,OFRNDS,       G0082490
                C                    DFONTM,DFONTP                                    G0082500
                C    SPEC'L  ARRAYS: DFRDTH,FRFRTH,VFDOTN                             G0082510
                C                                                                     G0082520
                C    PAGE 1B                                                          G0082530
                C     INPUT SCALAR : ZERO                                             G0082540
                C     LOCAL  ARRAYS: CFLOCB,CFLOCF                                    G0082550
                C                                                                     G0082560
                C    PAGE 2A                                                          G0082570
                C     LOCAL  ARRAYS: GR1LIS,JGADJV                                    G0082580
                C                                                                     G0082590
                C    PAGE 2B                                                          G0082600
                C     INPUT SCALARS: NGRPS,NULL                                       G0082610
                C     INPUT  ARRAYS: JTYFRN                                           G0082620
                C     LOCAL  ARRAYS: LG1CLC                                           G0082630
                C                                                                     G0082640
                C    PAGE 3A                                                          G0082650
                C     INPUT SCALAR : NBALNS                                           G0082660
                C     INPUT  ARRAYS: ACCUMO,LFRNT                                     G0082670
                C     LOCAL  ARRAYS: ACCUM ,GR2LIS                                    G0082680
                C                                                                     G0082690
                C    PAGE 3B                                                          G0082700
                C     INPUT SCALARS: NFPTMX,NGRPMX,NCOMPS                             G0082710
                C     LOCAL  ARRAYS: LG2CLC,ENHCF,VOLCF,DUMMY1,DUMMY2                 G0082720
                C                                                                     G0082730
                C    PAGE 4A                                                          G0082740
                C     INPUT  ARRAYS: GVCXHO,GVCXVO,GVCYHO,GVCYVO                      G0082750
                C     LOCAL  ARRAYS: GVCXH ,GVCXV ,GVCYH ,GVCYV ,GR3LIS,LG3CLC        G0082760
                C                                                                     G0082770
                C    PAGE 4B                                                          G0082780
                                                                                      G0082790
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                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
                C     INPUT SCALAR : CSYSTM                                           G0082800
                C                                                                     G0082810
                C    PAGE 5A                                                          G0082820
                C     INPUT SCALARS: NEDGES,TEST,NEDGMX                               G0082830
                C     INPUT  ARRAYS: FLTMXO,FLTMYO,FLTMTO,J1EFEC,J1EDGE               G0082840
                C     LOCAL  ARRAYS: FLTMXA,FLTMYA,FLTMTA,EDGLIS,LEDCLC               G0082850
                C                                                                     G0082860
                C    PAGE 5B - NOTHING NEW                                            G0082870
                C                                                                     G0082880
                C    PAGE 6A                                                          G0082890
                C     INPUT  ARRAYS: DXCFLO,DYCFLO,JGRPIJ,JEDGOG                      G0082900
                C     LOCAL  ARRAYS: DXCFL ,DYCFL ,FTMXCN,FTMYCN                      G0082910
                C                                                                     G0082920
                C    PAGE 6B                                                          G0082930
                C     INPUT SCALARS: CENDIS,ZERO(AGAIN)                               G0082940
                C     LOCAL  ARRAYS: DFLSUM,CFX,CFY                                   G0082950
                C                                                                     G0082960
                C    PAGE 7A                                                          G0082970
                C     INPUT  ARRAY : JTYFRN(AGAIN)                                    G0082980
                C     LOCAL  ARRAYS: DFCX,DFCY                                        G0082990
                C                                                                     G0083000
                C    PAGE 7B                                                          G0083010
                C     INPUT SCALAR : TRANSP                                           G0083020
                C     INPUT  ARRAY : EQTYPE                                           G0083030
                C     LOCAL  ARRAYS: DFLOW,DFTMX,DFTMY                                G0083040
                C                                                                     G0083050
                C    PAGE 8A                                                          G0083060
                C     INPUT SCALAR : MATCHC                                           G0083070
                C     INPUT  ARRAYS: EDSIGN,JFPT,JEDGOF                               G0083080
                C                                                                     G0083090
                C    PAGE 8B                                                          G0083100
                C     INPUT SCALARS: PRTBTN,SCALE,JBDIAG                              G0083110
                C     LOCAL  ARRAY : DACCUM                                           G0083120
                C                                                                     G0083130
                C    PAGE 9A                                                          G0083140
                C     INPUT SCALARS: NHELLS,NDIRS                                     G0083150
                C     INPUT  ARRAYS: SRCETO,SPLITO,JGPSC                              G0083160
                C     LOCAL  ARRAYS: SRCETN,SPLIT                                     G0083170
                C                                                                     G0083180
                C    PAGE 9B                                                          G0083190
                C     LOCAL  ARRAYS: DSRCET,CFLOCB(AGAIN)                             G0083200
                C                                                                     G0083210
                C    PAGE 10A                                                         G0083220
                C     INPUT SCALARS: JVAR,NULL                                        G0083230
                C     INPUT  ARRAYS: J1CONX,NNEIBS,JCONX                              G0083240
                C    OUTPUT  ARRAY : COEFFS                                           G0083250
ISN      97           NEQNS=NVARS                                                     G0083260
                C        IF NEQNS DOES NOT EQUAL NVARS                                G0083270
                C        THEN THE PROGRAM MUST BE REWRITTEN.                          G0083280
                C                                                                     G0083290
ISN      98           NDMCHF=73                                                       G0083300
ISN      99           IF (NDMCHF.NE.NBANMX) WRITE(6,102)NBANMX,NDMCHF                 G0083310
ISN     101           NBANDM=JOFSMX-JOFSMN+1                                          G0083320
ISN     102           IF (NBANDM.GT.NDMCHF) WRITE(6,103)NBANDM,NDMCHF                 G0083330
ISN     104       102 FORMAT(' ***+++ALDRVS: NBANMX, WHICH EQUALS',I4,                G0083340
                                                                                      G0083350
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                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
                     +      ' AND NDMCHF, WHICH EQUALS',I4,' SHOULD BE EQUAL')          G0083360
ISN      105       103 FORMAT(' ***+++ALDRVS: NBANDM, WHICH EQUALS ',I4,               G0083370
                     +      ', IS LARGER THAN NDMCHF, WHICH EQUALS',I4)                G0083380
                C                                                                       G0083390
ISN      106            LFICT=L2SYMM.AND.(JTYRFL(JGRPJ).EQ.2)                           G0083400
                C      OUTP =.TRUE.  MIGHT BE USEFUL SOME DAY.                         G0083410
                C      LPTRB=.TRUE.  MIGHT BE USEFUL SOME DAY.                         G0083420
                C                                                                       G0083430
ISN      107            JCSTA=J1CONX(JGRPJ)                                             G0083440
ISN      108            JCFIN=JCSTA+NNEIBS(JGRPJ)-1                                     G0083450
                C                                                                       G0083460
ISN      109               DO 116 JG=1,NGRPS                                            G0083470
ISN      110                  JCXLIL(JG)=NULL                                           G0083480
ISN      111         114   CONTINUE                                                    G0083490
ISN      112               DO 116 JCONXJ=JCSTA,JCFIN                                   G0083500
ISN      113                  JCXLIL(JNEIBR(JCONXJ))=JCONXJ                            G0083510
ISN      114         116   CONTINUE                                                    G0083520
                C                                                                       G0083530
ISN      115            IF (CALPRO) THEN                                             G0083540
ISN      116               CALL SUPROP(JGRPJ,63)                                     G0083550
                C           I.E. CALL SUBROUTINE SUPROP(JGRPJ,LCTNPN)                 G0083560
ISN      117               IF (IERR.GT.0) RETURN                                     G0083570
ISN      119               END IF                                                    G0083580
                C                                                                       G0083590
ISN      120            IF (CALGRI) THEN                                             G0083600
ISN      121               IGRP=IOFGRP(JGRPJ)                                        G0083610
ISN      122               ISTART=IOFGRP(JADJAC(3,JGRPJ))                            G0083620
                C                OR ISTART=IGRP-1  FOLLOWED BY                      G0083630
                C                   IF (ISTART.LT.1  .AND..NOT.L2SYMM) ISTART=NOS   G0083640
ISN      123               IFINIS=IOFGRP(JADJAC(1,JGRPJ))                            G0083650
                C                OR IFINIS=IGRP+1  FOLLOWED BY                      G0083660
                C                   IF (IFINIS.GT.NOS.AND..NOT.L2SYMM) IFINIS=1     G0083670
ISN      124               IF (LFICT) THEN                                           G0083680
ISN      125                  IF (IGRP.EQ.3)     IIMAGE=1                          G0083690
ISN      127                  IF (IGRP.EQ.NOS-2) IIMAGE=NOS                        G0083700
ISN      129                  ISTART=MINO(IGRP,IIMAGE)                             G0083710
ISN      130                  IFINIS=MAXO(IGRP,IIMAGE)                             G0083720
ISN      131               END IF                                                    G0083730
                C                                                                       G0083740
ISN      132               CALL CTFCFS(L2SYMM,ISTART,IFINIS,NOS,NRS,NDMAX,NGRPMX,    G0083750
                     1                  DT,DCENDS,CENDIS,GX,GY,                     G0083760
                     2                  FRNDIS,OFRNDS,DFDWTH,DFDWTP,                G0083770
                     3                  DFRDTH,FRFRTH,VFDOTH,XIRING,YIRING,         G0083780
                     4                  GRAVP)                                      G0083790
                C           I.E. CALL CTFCFS(L2SYMM,JOSTA,JOFIN,NOS,NRS,NDMAX,NGRPMX,G0083800
                C                            DT,DCENDS,CENDIS,GX,GY,                G0083810
                C                            FRNDIS,OFRNDS,DFDWTH,DFDWTP,           G0083820
                C                            DFRDTH,FRFRTH,VFDOTH,XIRING,YIRING,    G0083830
                C                            GRAVP)                                 G0083840
ISN      133            END IF                                                       G0083850
                C                                                                       G0083860
                C      ALSO INITIALIZE THE COLLECTOR FOR THE JACOBIAN.                  G0083870
ISN      134            DO 126 JG=1,NGRPS                                            G0083880
ISN      135               DO 124 JEQN=1,NEQNS                                       G0083890
ISN      136                  CFLOCB(JEQN,JG)=ZERO                                   G0083900
                                                                                        G0083910
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                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
ISN      137               CFLOCF(JEQN,JG)=ZERO                                      G0083920
                C           CFLOCF IS INITIALIZED JUST IN CASE.                       G0083930
ISN      138         124   CONTINUE                                                  G0083940
ISN      139         126 CONTINUE                                                    G0083950
                C                                                                       G0083960
                C         NG1CLS - NUMBER OF PERTURBED GROUPS.                      G0083970
                C         NG2CLS - NUMBER OF ACCUMULATION CALCULATIONS.             G0083980
                C         NG3CLS - NUMBER OF GVC(XY)(HV) CALCULATIONS.              G0083990
                C                                                                   G0084000
                C         GR1LIS: THE GROUPS FOR WHICH CFLOCB IS TO BE CALCULATED.  G0084010
                C                                                                   G0084020
ISN      140            JCALC=0                                                     G0084030
ISN      141            JSTART=J1CONX(JGRPJ)                                        G0084040
ISN      142            JFINIS=JSTART+NNEIBS(JGRPJ)-1                               G0084050
ISN      143            DO 132 JCONXJ=JSTART,JFINIS                                 G0084060
ISN      144               JGRP2=JNEIBR(JCONXJ)                                     G0084070
ISN      145               JCALC=JCALC+1                                            G0084080
ISN      146               GR1LIS(JCALC)=JGRP2                                      G0084090
ISN      147               IF (JTYRFL(JGRP2).EQ.2) THEN                             G0084100
                C                 THIS IS BECAUSE FICTITIOUS GROUPS ARE NOT INCLUDED G0084110
                C                 IN THE CONNECTION TABLES.                         G0084120
ISN      148                  JCALC=JCALC+1                                         G0084130
ISN      149                  GR1LIS(JCALC)=JRFLIN(JGRP2)                           G0084140
ISN      150               END IF                                                   G0084150
ISN      151         132 CONTINUE                                                    G0084160
ISN      152            NG1CLS=JCALC                                                G0084170
ISN      153            DO 136 JG=1,NGRPS                                           G0084180
ISN      154               LG1CLC(JG)=.FALSE.                                       G0084190
ISN      155         136 CONTINUE                                                    G0084200
ISN      156            DO 138 JCALC=1,NG1CLS                                       G0084210
ISN      157               LG1CLC(GR1LIS(JCALC))=.TRUE.                             G0084220
ISN      158         138 CONTINUE                                                    G0084230
                C                                                                   G0084240
                C         FOR EACH OF THE FOLLOWING SUBROUTINE CALLS,               G0084250
                C         WE FOLLOW THIS GENERAL PROCEDURE:                         G0084260
                C                                                                   G0084270
                C         1. SET ARRAY TO ARRAYO FOR ->EVERY<- ELEMENT.             G0084280
                C         2. ASSEMBLE THE LIST OF PERTURBED GROUPS/EDGES.           G0084290
                C         3. CALCULATE THE LOGICAL ARRAY DESCRIBING THIS LIST.      G0084300
                C         4. CALL THE SUBROUTINE.                                   G0084310
                C         5. DO NOT TRY TO "CLEAN UP" ARRAY OR ARRAYO               G0084320
                C            AFTER CALLING THE SUBROUTINE.                          G0084330
                C                                                                   G0084340
                C                                                                   G0084350
                C         CALCULATE THE PERTURBED ACCUM.                            G0084360
                C                                                                   G0084370
ISN      159            DO 170 JG=1,NGRPS                                           G0084380
ISN      160               DO 160 IBALN=1,NBALNS                                    G0084390
ISN      161                  ACCUM(IBALN,JG)=ACCUMO(IBALN,JG)                      G0084400
ISN      162         160   CONTINUE                                                  G0084410
ISN      163         170 CONTINUE                                                    G0084420
ISN      164            DO 172 JG=1,NGRPS                                           G0084430
ISN      165               LG2CLC(JG)=.FALSE.                                       G0084440
ISN      166         172 CONTINUE                                                    G0084450
ISN      167            LG2CLC(JGRPJ)=.TRUE.                                        G0084460
ISN      168            IF (LFRNT(JGRPJ)) LG2CLC(JGPTNR(JGRPJ))=.TRUE.              G0084470
```

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                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
ISN      170          IF (JGRPJ.EQ.1) THEN                                          G0084480
ISN      171             DO 174 JO=1,NOS                                            G0084490
ISN      172                JGP=JGRPJ(JO,2)                                         G0084500
ISN      173                LG2CLC(JGP)=.TRUE.                                      G0084510
ISN      174                IF (LFRNT(JGP)) LG2CLC(JGPTNR(JGP))=.TRUE.              G0084520
ISN      176       174    CONTINUE                                                  G0084530
ISN      177             ELSE                                                       G0084540
ISN      178                IF (CALGRI) THEN                                        G0084550
ISN      179                   DO 175 JG=1,NGRPS                                    G0084560
ISN      180                      IF (LG1CLC(JG)) LG2CLC(JG)=.TRUE.                 G0084570
C                                    THIS ALLOWS GR2LIS TO BE LARGER THAN GR1LIS,   G0084580
C                                    IF THIS IS DESIRED.                           G0084590
ISN      182       175            CONTINUE                                          G0084600
ISN      183                   ELSE                                                 G0084610
ISN      184                      DO 176 IDIR=1,4                                   G0084620
ISN      185                         JGP=JADJAC(IDIR,JGRPJ)                         G0084630
ISN      186                         IF (JGP.GT.NULL) THEN                          G0084640
ISN      187                            LG2CLC(JGP)=.TRUE.                          G0084650
ISN      188                            IF (LFRNT(JGP)) LG2CLC(JGPTNR(JGP))=.TRUE.  G0084660
ISN      190                         END IF                                         G0084670
ISN      191                         IF (LFRNT(JGRPJ)) THEN                         G0084680
ISN      192                            JGP2=JADJAC(IDIR,JGPTNR(JGRPJ))             G0084690
ISN      193                            IF (JGP2.GT.NULL) LG2CLC(JGP2)=.TRUE.       G0084700
ISN      195                         END IF                                         G0084710
ISN      196       176            CONTINUE                                          G0084720
ISN      197                   END IF                                               G0084730
ISN      198                END IF                                                  G0084740
ISN      199             JCALC=0                                                    G0084750
ISN      200             DO 178 JG=1,NGRPS                                          G0084760
ISN      201                IF (LG2CLC(JG)) THEN                                    G0084770
ISN      202                   JCALC=JCALC+1                                        G0084780
ISN      203                   GR2LIS(JCALC)=JG                                     G0084790
ISN      204                END IF                                                  G0084800
ISN      205       178    CONTINUE                                                  G0084810
ISN      206             NG2CLS=JCALC                                               G0084820
C                                                                                   G0084830
ISN      207             CALL ACUMCL(.FALSE.,.FALSE.,TEST,                          G0084840
                        1           NFPTMX,NGRPMX,NATRMX,NCOMPS,NBALNS,            G0084850
                        2           NG2CLS,GR2LIS,ENHCF,VOLCF,                     G0084860
                        3           DUMMY1,DUMMY2,DUMMY3,ACCUM,ACUMF)              G0084870
C                                  I.E. CALL ACUMCL(ALGRPS,INITL2,TEST,            G0084880
C                                                   NFPTMX,NGRPMX,NATRMX,NCOMPS,NBALNS,  G0084890
C                                                   NCALCS,GRPLIS,ENHCF,VOLCF,     G0084900
C                                                   CONCL,CONCV,SCAREA,ACCUM,ACUMF)  G0084910
C                                                                                   G0084920
C                                                                                   G0084930
C                                                                                   G0084940
C                                                                                   G0084950
C           IF NECESSARY, CALCULATE THE PERTURBED GVC(XY)(HV).                      G0084960
C           SET GVC(XY)(HV) TO GVC(XY)(HV)O UNCONDITIONALLY, JUST IN CASE.          G0084970
ISN      208             DO 190 JG=2,NGRPS                                          G0084980
ISN      209                GVCXH(JG)=GVCXHO(JG)                                    G0084990
ISN      210                GVCXV(JG)=GVCXVO(JG)                                    G0085000
ISN      211                GVCYH(JG)=GVCYHO(JG)                                    G0085010
ISN      212                GVCYV(JG)=GVCYVO(JG)                                    G0085020
                                                                                    G0085030
```



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                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
ISN      213       190 CONTINUE                                                    G0085040
C                                                                                   G0085050
ISN      214             DO 192 JG=1,NGRPS                                          G0085060
ISN      215                LG3CLC(JG)=.FALSE.                                      G0085070
ISN      216       192    CONTINUE                                                  G0085080
ISN      217             NG3CLS=0                                                   G0085090
ISN      218             IF (CALGRI) THEN                                           G0085100
ISN      219                DO 194 JCALC1=1,NG1CLS                                  G0085110
ISN      220                   GR3LIS(JCALC1)=GR1LIS(JCALC1)                        G0085120
ISN      221       194       CONTINUE                                              G0085130
ISN      222                NG3CLS=NG1CLS                                           G0085140
ISN      223                DO 198 JCALC=1,NG3CLS                                   G0085150
ISN      224                   LG3CLC(GR3LIS(JCALC))=.TRUE.                         G0085160
ISN      225       198       CONTINUE                                              G0085170
C                                                                                   G0085180
ISN      226             CALL GVCFCL(.FALSE.,NGRPMX,NG3CLS,GR3LIS,                  G0085190
                        1           GVCXH,GVCXV,GVCYH,GVCYV)                        G0085200
C                                  I.E. CALL GVCFCL(ALGRPS,NGRPMX,NCALCS,GRPLIS,   G0085210
C                                                   GVCXH,GVCXV,GVCYH,GVCYV)       G0085220
C                                                                                   G0085230
ISN      227             END IF                                                     G0085240
C                                                                                   G0085250
C           CALCULATE THE PERTURBED FLTM(XYT)A.                                     G0085260
C                                                                                   G0085270
ISN      228             DO 290 JEDGEJ=1,NEDGES                                     G0085280
C                           FLORH(1,JEDGEJ)=FLORHO(1,JEDGEJ) IS UNNEEDED (FOR THE MOMENT).  G0085290
C                           FLORH(2,JEDGEJ)=FLORHO(2,JEDGEJ) IS UNNEEDED (FOR THE MOMENT).  G0085300
ISN      229                DO 280 IBALN=1,NBALNS                                   G0085310
ISN      230                   FLTMXA(IBALN,JEDGEJ)=FLTMXO(IBALN,JEDGEJ)            G0085320
ISN      231                   FLTMYA(IBALN,JEDGEJ)=FLTMYO(IBALN,JEDGEJ)            G0085330
ISN      232                   FLTMTA(IBALN,JEDGEJ)=FLTMTO(IBALN,JEDGEJ)            G0085340
ISN      233       280       CONTINUE                                              G0085350
ISN      234       290    CONTINUE                                                  G0085360
C                                                                                   G0085370
ISN      235             JCALC=0                                                    G0085380
ISN      236             IF (.NOT.CALGRI) THEN                                      G0085390
ISN      237                JSTART=J1EFEC(JGRPJ)                                    G0085400
ISN      238                JFINIS=J1EFEC(JGRPJ+1)-1                                G0085410
ISN      239                DO 292 JEFECJ=JSTART,JFINIS                             G0085420
ISN      240                   JCALC=JCALC+1                                        G0085430
ISN      241                   EDGLIS(JCALC)=JIEDGE(JEFECJ)                         G0085440
ISN      242       292       CONTINUE                                              G0085450
ISN      243                END IF                                                  G0085460
ISN      244             IF (CALGRI) THEN                                           G0085470
ISN      245                DO 294 JEDGEJ=1,NEDGES                                  G0085480
C                              THE FOLLOWING CALCULATION OF LCALC IS THIS COMPLICATED,  G0085490
C                              BECAUSE THE SUBSCRIPTS JGRP2 AND JGRP5               G0085500
C                              SOMETIMES EQUAL NULL.                                G0085510
ISN      246                   LCALC=.FALSE.                                        G0085520
ISN      247                   JGRP2=JGRPOE(2,JEDGEJ)                               G0085530
ISN      248                   JGRP5=JGRPOE(5,JEDGEJ)                               G0085540
ISN      249                   IF (JGRP2.GT.NULL) LCALC=LG1CLC(JGRP2)               G0085550
ISN      251                   IF (JGRP5.GT.NULL) LCALC=LG1CLC(JGRP5).OR.LCALC      G0085560
ISN      253                   IF (LCALC) THEN                                      G0085570
ISN      254                      JCALC=JCALC+1                                     G0085580
ISN      255                      EDGLIS(JCALC)=JEDGEJ                              G0085590
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                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
ISN      256                END IF                                                  G0085600
ISN      257      294     CONTINUE                                                  G0085610
ISN      258            END IF                                                     G0085620
ISN      259          NEDCLS=JCALC                                                 G0085630
ISN      260          DO 296 JEDGEJ=1,NEDGES                                       G0085640
ISN      261            LEDCLC(JEDGEJ)=.FALSE.                                     G0085650
ISN      262      296 CONTINUE                                                     G0085660
ISN      263          DO 298 JCALC=1,NEDCLS                                        G0085670
ISN      264            LEDCLC(EDGLIS(JCALC))=.TRUE.                               G0085680
ISN      265      298 CONTINUE                                                     G0085690
                C                                                                 G0085700
ISN      266          CALL FLTMCL(.FALSE.,TEST,NEDGMX,NOMAX,NCOMPS,NBALNS,        G0085710
                     1            NEDCLS,EDGLIS,                                  G0085720
                     2            FLTMXA,FLTMYA,FLTMTA)                           G0085730
                C        I.E. CALL FLTMCL(ALEDGS,TEST,NEDGMX,NOMAX,NCOMPS,NBALNS, G0085740
                C                         NCALCS,EDGLIS,                          G0085750
                C                         FLTMXA,FLTMYA,FLTMTA)                   G0085760
                C                                                                 G0085770
                C                                                                 G0085780
                C        COMBINE THE PERTURBED ACCUM AND THE PERTURBED FLTM(XYT)A  G0085790
                C        TO CALCULATE CFLOCB.                                     G0085800
                C        THE PLAN IS TO FIRST CALCULATE DFLSUM, AND THEN COMBINE  G0085810
                C        DFLSUM WITH DACCUM TO OBTAIN A PRELIMINARY ESTIMATE OF CFLOCB. G0085820
                C        THIS ESTIMATE IS PRELIMINARY BECAUSE SRCECL MIGHT MODIFY  G0085830
                C        SOME OF THE ELEMENTS OF CFLOCB.                          G0085840
                C                                                                 G0085850
ISN      267          DO 390 JCALC=1,NGICLS                                        G0085860
ISN      268            JGP=GRILIS(JCALC)                                          G0085870
                C                                                                 G0085880
ISN      269            IF (JGP.EQ.1) THEN                                         G0085890
                C              THE DISCRETE FOURIER TRANSFORM LOOKS ELEGANT.      G0085900
                C              HOWEVER, BOTH R AND DTHETA VARY.                   G0085910
                C              THEREFORE, WE USE LEAST SQUARES.                   G0085920
                C                                                                 G0085930
ISN      270              DO 310 IBALN=1,NBALNS                                    G0085940
ISN      271                DXCFL(IBALN)=DXCFLO(IBALN)                             G0085950
ISN      272                DYCFL(IBALN)=DYCFLO(IBALN)                             G0085960
ISN      273      310       CONTINUE                                               G0085970
ISN      274                DO 318 I=1,NOS                                         G0085980
ISN      275                  JEDGEJ=I                                             G0085990
ISN      276                  DO 316 IBALN=1,NBALNS                                G0086000
ISN      277                    FTMXCN(IBALN,I)=FLTMXA(IBALN,JEDGEJ)               G0086010
ISN      278                    FTMYCN(IBALN,I)=FLTMYA(IBALN,JEDGEJ)               G0086020
ISN      279      316           CONTINUE                                           G0086030
ISN      280      318         CONTINUE                                             G0086040
                C              IT IS ASSUMED THAT NONE OF THE GRID POINTS ADJACENT TO  G0086050
                C              THE CENTRE GRID POINT ARE ON THE STEAM FRONT.      G0086060
                C              IT IS HOPED (1987/02/13) THAT A VIOLATION          G0086070
                C              OF THIS ASSUMPTION SHOULD NOT CAUSE PROBLEMS.      G0086080
                C                                                                 G0086090
ISN      281              CALL HLLSSQ(NOMAX,NOS,NBALNS,                            G0086100
                     1                XIRING,YIRING,FTMXCN,FTMYCN,                G0086110
                     2                DXCFL,DYCFL)                                G0086120
                C              I.E. CALL HLLSSQ(NOMAX,NOS,NBALNS,                 G0086130
                C                               XIRING,YIRING,FTMXCN,FTMYCN,      G0086140
                C                               DXCFL,DYCFL)                      G0086150
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                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
                C                                                                 G0086160
ISN      282              DO 320 IBALN=1,NBALNS                                    G0086170
ISN      283                DFLSUM(IBALN) = ( +(DXCFL(IBALN)-DXCFLO(IBALN))      G0086180
                     1                       +(DYCFL(IBALN)-DYCFLO(IBALN)) )     G0086190
                C              THE SIGNS MUST BE CHECKED                          G0086200
                C              VERY CAREFULLY  (1987/02/13).                      G0086210
ISN      284      320       CONTINUE                                               G0086220
ISN      285            END IF                                                     G0086230
                C                                                                 G0086240
                C        ALL OTHER GROUPS.                                        G0086250
                C                                                                 G0086260
ISN      286          IF (JGP.GT.1) THEN                                           G0086270
ISN      287            DO 332 IBALN=1,NBALNS                                      G0086280
ISN      288              DFLSUM(IBALN)=ZERO                                       G0086290
ISN      289      332       CONTINUE                                               G0086300
ISN      290              CFX(1)=GVCXH(JGP)                                        G0086310
ISN      291              CFX(2)=GVCXV(JGP)                                        G0086320
ISN      292              CFX(3)=GVCXH(JGP)                                        G0086330
ISN      293              CFX(4)=GVCXV(JGP)                                        G0086340
ISN      294              CFY(1)=GVCYH(JGP)                                        G0086350
ISN      295              CFY(2)=GVCYV(JGP)                                        G0086360
ISN      296              CFY(3)=GVCYH(JGP)                                        G0086370
ISN      297              CFY(4)=GVCYV(JGP)                                        G0086380
ISN      298              IF (CALGRI) THEN                                         G0086390
ISN      299                DCFX(1)=GVCXH(JGP)-GVCXHO(JGP)                         G0086400
ISN      300                DCFX(2)=GVCXV(JGP)-GVCXVO(JGP)                         G0086410
ISN      301                DCFX(3)=GVCXH(JGP)-GVCXHO(JGP)                         G0086420
ISN      302                DCFX(4)=GVCXV(JGP)-GVCXVO(JGP)                         G0086430
ISN      303                DCFY(1)=GVCYH(JGP)-GVCYHO(JGP)                         G0086440
ISN      304                DCFY(2)=GVCYV(JGP)-GVCYVO(JGP)                         G0086450
ISN      305                DCFY(3)=GVCYH(JGP)-GVCYHO(JGP)                         G0086460
ISN      306                DCFY(4)=GVCYV(JGP)-GVCYVO(JGP)                         G0086470
ISN      307              END IF                                                   G0086480
                C                                                                 G0086490
ISN      308            JTYFRJ=JTYFRM(JGP)                                         G0086500
                C                                                                 G0086510
                C              ADD UP THE DFLOW TERMS FOR THE TRANSPORT EQUATIONS.  G0086520
                C              BUT NOT YET FOR THE MATCHING CONDITIONS.           G0086530
ISN      309            DO 350 IDIR=1,NDIRS                                        G0086540
ISN      310              JEDGEJ=JEDGOG(IDIR,JGP)                                  G0086550
ISN      311              IF (JEDGEJ.GT.NULL) THEN                                 G0086560
                C                CHNGE1  LCHNG1                                   G0086570
                C                CHNGE2  LCHNG2                                   G0086580
ISN      312                LCHNG1=LEDCLC(JEDGEJ)                                  G0086590
ISN      313                LCHNG2=LG3CLC(JGP)                                     G0086600
ISN      314                IF (LCHNG1.OR.LCHNG2) THEN                             G0086610
ISN      315                  DO 334 IBALN=1,NBALNS                                G0086620
ISN      316                    DFLOW(IBALN)=ZERO                                  G0086630
ISN      317      334           CONTINUE                                           G0086640
ISN      318                  IF (LCHNG1) THEN                                     G0086650
                C                  THIS LOOP IS EXECUTED ROUGHLY HALF THE TIME.   G0086660
ISN      319                    DO 336 IBALN=1,NBALNS                              G0086670
                C                    EQCD=EQTYPE(IBALN,IEQCDD(IBALN,JGP))       G0086680
                C                    IF (EQCD.EQ.TRANSP.OR.EQCD.EQ.BOTH) THEN   G0086690
                C                    MIGHT NOT BE NEEDED.                       G0086700
ISN      320                        DFTMX(IBALN) = ( FLTMXA(IBALN,JEDGEJ)        G0086710
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                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
                     !                                                                  G0086720
ISN      321         !                          DFTMY(IBALN) = ( -FLTMXO(IBALN,JEDGEJ) )                    G0086730
ISN      322         !                                         -FLTMYO(IBALN,JEDGEJ) )                    G0086740
                     1                          DFLOW(IBALN) = ( CFX(IDIR)*DFTMX(IBALN)                     G0086750
                                                               +CFY(IDIR)*DFTMY(IBALN) )                    G0086760
                C                             END IF  MIGHT NOT BE NEEDED.                                  G0086770
ISN      323     336                       CONTINUE                                                         G0086780
ISN      324                              END IF                                                            G0086790
ISN      325                           IF (LCHNG2) THEN                                                     G0086800
                C                            THIS LOOP IS EXECUTED A SMALL FRACTION                        G0086810
                C                            OF THE TIME.                                                  G0086820
ISN      326                              DO 338 IBALN=1,NBALNS                                             G0086830
ISN      327                              EQCD=EQTYPE(IBALN,IEQCOD(IBALN,JGP))                              G0086840
ISN      328                              IF (EQCD.EQ.TRANSP.OR.EQCD.EQ.BOTH)                               G0086850
                     1                    DFLOW(IBALN) = ( DFLOW(IBALN)                                    G0086860
                     2                                   + DCFX(IDIR)*FLTMXA(IBALN,JEDGEJ)                 G0086870
                     3                                   + DCFY(IDIR)*FLTMYA(IBALN,JEDGEJ) )               G0086880
ISN      330     338                       CONTINUE                                                         G0086890
ISN      331                              END IF                                                            G0086900
                C                            EDSIGN IS INITIALIZED IN THE MAIN PROGRAM.                    G0086910
ISN      332                           IF (EDSIGN(IDIR+IDIR).GT.0) THEN                                     G0086920
ISN      333                              DO 344 IBALN=1,NBALNS                                             G0086930
ISN      334                              EQCD=EQTYPE(IBALN,IEQCOD(IBALN,JGP))                              G0086940
ISN      335                              IF (EQCD.EQ.TRANSP.OR.EQCD.EQ.BOTH)                               G0086950
                     1                    DFLSUM(IBALN)=DFLSUM(IBALN)-DFLOW(IBALN)                         G0086960
                C                              DFLOW DOES NOT INCLUDE THE DT FACTOR.                       G0086970
                C                              SINCE FLTMXA AND FLTMYA DO NOT INCLUDE IT.                  G0086980
ISN      337     344                       CONTINUE                                                         G0086990
ISN      338                              ELSE                                                              G0087000
ISN      339                              DO 346 IBALN=1,NBALNS                                             G0087010
ISN      340                              EQCD=EQTYPE(IBALN,IEQCOD(IBALN,JGP))                              G0087020
ISN      341                              IF (EQCD.EQ.TRANSP.OR.EQCD.EQ.BOTH)                               G0087030
                     1                    DFLSUM(IBALN)=DFLSUM(IBALN)+DFLOW(IBALN)                         G0087040
                C                              DFLOW DOES NOT INCLUDE THE DT FACTOR.                       G0087050
                C                              SINCE FLTMXA AND FLTMYA DO NOT INCLUDE IT.                  G0087060
ISN      343     346                       CONTINUE                                                         G0087070
ISN      344                              END IF                                                            G0087080
                C                                                                                          G0087090
ISN      345                                 END IF                                                         G0087100
ISN      346                              END IF                                                            G0087110
ISN      347     350                   CONTINUE                                                             G0087120
                C                                                                                          G0087130
                C                     NOW ADD UP THE FLOW TERMS FOR THE MATCHING CONDITIONS.               G0087140
ISN      348                           IF (LFRNT(JGP)) THEN                                                 G0087150
ISN      349                              JFPTJ=JFPT(JGP)                                                   G0087160
ISN      350                              JEDGE1=JEDGOF(1,JFPTJ)                                            G0087170
ISN      351                              JEDGE2=JEDGOF(2,JFPTJ)                                            G0087180
ISN      352                              DO 360 IBALN=1,NBALNS                                             G0087190
ISN      353                                 EQCD=EQTYPE(IBALN,IEQCOD(IBALN,JGP))                           G0087200
ISN      354                                 IF (EQCD.EQ.MATCHC.OR.EQCD.EQ.BOTH) THEN                       G0087210
ISN      355                                    DFTMT1=FLTMTA(IBALN,JEDGE1)-FLTMTO(IBALN,JEDGE1)            G0087220
ISN      356                                    DFTMT2=FLTMTA(IBALN,JEDGE2)-FLTMTO(IBALN,JEDGE2)            G0087230
ISN      357                                    DFLSUM(IBALN)=DFLSUM(IBALN)-DFTMT1+DFTMT2                   G0087240
                C                                    THESE SIGNS SHOULD BE CHECKED VERY CAREFULLY.         G0087250
ISN      358                                 END IF                                                         G0087260
ISN      359     360                   CONTINUE                                                             G0087270
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                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
ISN      360                                 END IF                                                         G0087280
                C                                                                                          G0087290
ISN      361                              END IF                                                            G0087300
                C                                                                                          G0087310
                CCCCC                 NOW THAT DFLSUM IS COMPUTED FOR ALL CASES,                           G0087320
                CCCCC                 CALCULATE DACCUM AND COMBINE WITH DFLSUM                              G0087330
                CCCCC                 TO OBTAIN A PRELIMINARY ESTIMATE OF CFLOCB.                           G0087340
                C                                                                                          G0087350
ISN      362                           DO 372 IBALN=1,NBALNS                                                G0087360
ISN      363                           DACCUM(IBALN)=ZERO                                                   G0087370
ISN      364     372                   CONTINUE                                                             G0087380
ISN      365                           IF (LG2CLC(JGP)) THEN                                                G0087390
ISN      366                              DO 374 IBALN=1,NBALNS                                             G0087400
ISN      367                              DACCUM(IBALN)=ACCUM(IBALN,JGP)-ACCUMO(IBALN,JGP)                  G0087410
ISN      368     374                   CONTINUE                                                             G0087420
ISN      369                             ELSE                                                               G0087430
ISN      370                              DO 376 IBALN=1,NBALNS                                             G0087440
ISN      371                              DACCUM(IBALN)=ZERO                                                G0087450
ISN      372     376                   CONTINUE                                                             G0087460
ISN      373                           END IF                                                               G0087470
                C                                                                                          G0087480
ISN      374                           DENOM=PRTBTN/SCALE                                                   G0087490
                CCCCC                 1. IT HAS BEEN DECIDED THAT THE INTERFACE                            G0087500
                CCCCC                    BETWEEN THE GRP REGIME AND THE RLG REGIME                         G0087510
                CCCCC                    SHOULD BE WITHIN THE SUBROUTINE ALSOLV.                           G0087520
                CCCCC                                                                                      G0087530
                CCCCC                 2. JGRPJ, AND ALSO PRTBTN AND SCALE, ARE SUBROUTINE PARAMETERS:      G0087540
                CCCCC                    DO NOT CHANGE ANY OF THEM !!                                      G0087550
                C                                                                                          G0087560
ISN      375                           DO 378 JEQN=1,NEQNS                                                  G0087570
ISN      376                           ILIQ=JEQN                                                            G0087580
ISN      377                           IVAP=JEQN+NEQNS                                                      G0087590
ISN      378                           CFLOCB(JEQN,JGP)                                                     G0087600
                     1                  = ( DACCUM(ILIQ) + DT*DFLSUM(ILIQ)                                  G0087610
                     2                    + DACCUM(IVAP) + DT*DFLSUM(IVAP)  )/DENOM                         G0087620
                C                       CONSISTENT WITH CTEQNS.                                            G0087630
ISN      379     378                   CONTINUE                                                             G0087640
                C                                                                                          G0087650
ISN      380     390 CONTINUE                                                                             G0087660
                CCCCC                                                                                      G0087670
                CCCCC                 NOW SUBTRACT THE EFFECT OF THE SOURCE TERMS FROM CFLOCB.              G0087680
                C                                                                                          G0087690
ISN      381                           DO 470 IWELL=1,NWELLS                                                G0087700
ISN      382                              DO 465 IDIR=1,NDIRS                                               G0087710
ISN      383                                 DO 460 IBALN=1,NBALNS                                          G0087720
ISN      384                                 SRCETH(IBALN,IDIR,IWELL)=SRCETO(IBALN,IDIR,IWELL)              G0087730
ISN      385     460                      CONTINUE                                                          G0087740
ISN      386                              SPLIT(IDIR,IWELL)=SPLITO(IDIR,IWELL)                              G0087750
ISN      387     465                   CONTINUE                                                             G0087760
ISN      388     470 CONTINUE                                                                             G0087770
                C                                                                                          G0087780
ISN      389                           CALL SRCECL(.TRUE.,.TRUE.,TEST,                                      G0087790
                     1                        NWELMX,NDIRMX,NBALNS,                                        G0087800
                     2                        SPLIT,SRCETH)                                                G0087810
                C                        I.E. CALL SRCECL(LCSPLT,LCSCTN,TEST,                              G0087820
                C                                         NWELMX,NDIRMX,NBALNS,                            G0087830
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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
                C                              SPLIT,SRCETM)                                    G0087840
                C                                                                               G0087850
ISN      390          DO 490 IWELL=1,NWELLS                                                     G0087860
ISN      391             DO 485 IDIR=1,NDIRS                                                    G0087870
ISN      392                JGP=JGPSC(IDIR,IWELL)                                               G0087880
ISN      393                IF (LG1CLC(JGP)) THEN                                               G0087890
                C                  IT HAS BEEN DECIDED THAT THE INTERFACE                       G0087900
                C                  BETWEEN THE GRP REGIME AND THE RLG REGIME                    G0087910
                C                  SHOULD BE WITHIN THE SUBROUTINE ALSOLV.                      G0087920
ISN      394                   DO 475 IBALN=1,NBALNS                                            G0087930
ISN      395                      DSRCET(IBALN) = ( SRCETM(IBALN,IDIR,IWELL)                    G0087940
                1                                 -SRCETO(IBALN,IDIR,IWELL)   )                 G0087950
ISN      396          475         CONTINUE                                                      G0087960
ISN      397                      DO 480 JEQN=1,NEQNS                                           G0087970
ISN      398                         ILIQ=JEQN                                                  G0087980
ISN      399                         IVAP=JEQN+NEQNS                                            G0087990
ISN      400                         CFLOCB(JEQN,JGP) = ( CFLOCB(JEQN,JGP)                      G0088000
                1                                        -DT*DSRCET(ILIQ)/DENOM                 G0088010
                2                                        -DT*DSRCET(IVAP)/DENOM   )             G0088020
ISN      401          480         CONTINUE                                                      G0088030
ISN      402                   END IF                                                           G0088040
ISN      403          485      CONTINUE                                                         G0088050
ISN      404          490   CONTINUE                                                            G0088060
                C                                                                               G0088070
                C        THE CALCULATION OF CFLOCB IS NOW COMPLETE.                             G0088080
                C                                                                               G0088090
                C        INITIALIZE THE COLUMN OF THE SYSTEM JACOBIAN MATRIX TO ZERO.           G0088100
                C                                                                               G0088110
ISN      405          JSTART=J1CONX(JGRPJ)                                                      G0088120
ISN      406          JFINIS=JSTART+NNEIBS(JGRPJ)-1                                             G0088130
ISN      407          DO 570 JCONXJ=JSTART,JFINIS                                               G0088140
ISN      408             DO 560 JEQN=1,NEQNS                                                    G0088150
ISN      409                COEFFS(JEQN,JVAR,JCONXJ)=ZERO                                       G0088160
ISN      410          560   CONTINUE                                                          G0088170
ISN      411          570 CONTINUE                                                            G0088180
                C                                                                               G0088190
                C        COPY CFLOCB INTO COEFFS.                                               G0088200
                C                                                                               G0088210
ISN      412          DO 590 JCONXJ=JCSTA,JCFIN                                                 G0088220
ISN      413             JGP=JNEIBR(JCONXJ)                                                     G0088230
ISN      414             DO 580 JEQN=1,NVARS                                                    G0088240
ISN      415                COEFFS(JEQN,JVAR,JCONXJ)=CFLOCB(JEQN,JGP)                           G0088250
ISN      416          580   CONTINUE                                                          G0088260
ISN      417          590 CONTINUE                                                            G0088270
                C                                                                               G0088280
                C        LINES 845/901 ARE RESERVED FOR CHECKING THE JACOBIAN.                  G0088290
                C                                                                               G0088300
ISN      418          RETURN                                                                    G0088310
ISN      419          END                                                                       G0088320
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STATISTICS SOURCE STATEMENTS = 404, PROGRAM SIZE = 118088 BYTES, PROGRAM NAME = ALDRVS PAGE: 169.

STATISTICS NO DIAGNOSTICS GENERATED.

ALDRVS END OF COMPILATION 33 ******

OPTIONS IN EFFECT: NOLIST NOMAP NOXREF NOGOSTMT NODECK SOURCE TERM NOOBJECT FIXED NOTEST TRMFLG SRCFLG
NOSYM NORENT SDUMP AUTODBL(NONE) NOSXM IL
OPT(0) LANGLVL(77) NOFIPS FLAG(I) NAME(MAIN) LINECOUNT(60) CHARLEN(500)

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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
                C.SUPROP                                                                        G0088330
                C                                                                               G0088340
                C  SOO.  CALL PROPTY FOR JGRPJ AND COUPLED GROUPS, IF ANY.                      G0088350
                C                                                                               G0088360
ISN        1        SUBROUTINE SUPROP(JGRPJ,LCTNPH)                                           G0088370
ISN        2        IMPLICIT DOUBLE PRECISION (A-H,K,O-Z)                                     G0088380
                C                                                                               G0088390
ISN        3        LOGICAL LFICT,LFRNC                                                       G0088400
                C                                                                               G0088410
ISN        4        LOGICAL EQMA01,EQMA10,VOUCPT,VOUCSC,EQUIL                                 G0088420
ISN        5        LOGICAL COORTR,TRACKF,OVTAKE,DATAFR,RESTRT                                G0088430
ISN        6        LOGICAL OUT,REPEAT,JCTEST,JTINIT,ITERPR,BYMEIT                            G0088440
ISN        7        DOUBLE PRECISION LAMBDA                                                   G0088450
ISN        8        DOUBLE PRECISION MO,MWOIL,MSOL,MGP                                        G0088460
ISN        9        DOUBLE PRECISION MOBGL,MOBWL,MOBOL,MOBTL                                  G0088470
ISN       10        LOGICAL RCOMOL                                                            G0088480
ISN       11        DOUBLE PRECISION MOBGR,MOBWR,MOBOR,MOBTR                                  G0088490
ISN       12        LOGICAL RCOMOR                                                            G0088500
ISN       13        LOGICAL LFRNT                                                             G0088510
ISN       14        LOGICAL LBWDOG,LBWDB                                                      G0088520
ISN       15        LOGICAL RCOMO,INJECT                                                      G0088530
ISN       16        DOUBLE PRECISION MOBG,MOBW,MOBO,MOBT                                      G0088540
                C                                                                               G0088550
ISN       17        COMMON/PRMBLK/SWC,SOIRR,SGIRR,SGPDUM,SWPDUM,KRGDUM,KROG,KROW,             G0088560
                1                  KRWDUM,KRODUM,KRGSGD,KROGSG,KROWSW,KRWSWD,KROSGD,        G0088570
                2                  KROSWD,PCWDUM,PCVDUM,                                    G0088580
                3                  LCTN,IERR,IWRONG                                         G0088590
ISN       18        COMMON/PVAPOR/PMAT(55),POIL(55),PSOL(55),DPMAT(55),DPOIL(55),             G0088600
                1                  DPSOL(55),DPDT(55),YMOLE(4,55),YO(55),YV(55),YS(55)      G0088610
ISN       19        COMMON/EQLBRM/PEQUIL,                                                     G0088620
                1                  EQMA01,EQMA10,VOUCPT,VOUCSC,EQUIL(55)                    G0088630
ISN       20        COMMON/VPCONS/AM,BM,AO,BO,CO,ASOL,BSOL,CSOL,TO(55)                        G0088640
ISN       21        COMMON/INJSPC/PGRDNT,TOTINJ,VAPINJ(28),HCBINJ(28),MATINJ(28),             G0088650
                1                  VLCTY,HC1INJ(28),HC2INJ(28),HC3INJ(28),                  G0088660
                2                  VO1INJ(28),VO2INJ(28),VWAINJ(28)                         G0088670
ISN       22        COMMON/GRIPRO/DT,DXFRNT,DISXM,DX(57),DISTX(58),MFRONT,NBLOKS,             G0088680
                1                  NG,NJAY,COORTR,TRACKF,OVTAKE,DATAFR,RESTRT               G0088690
ISN       23        COMMON/LOGNIS/OUT,REPEAT,JCTEST,JTINIT,ITERPR,BYMEIT                      G0088700
ISN       24        COMMON/STATEV/SWP(55),SGP(55),SOP(55),T(55),P(55),                        G0088710
                1                  XMOLE(3,55),XO(55),XSOL(55),XW(55)                       G0088720
ISN       25        COMMON/FLUPRO/DWP(55),DOP(55),DGP(55),UWP(55),UOP(55),UGP(55),            G0088730
                1                  CWP(55),COP(55),CGP(55),KO(55),KSOL(55),LAMBDA(55),      G0088740
                2                  DENSOL(55),DENSOW(55),DENSOS(55),                        G0088750
                3                  DFSPCW(55),DFSPCO(55),DFSPCV(55),GASCON                  G0088760
ISN       26        COMMON/HVAPOR/HVAPS,HVAPO,HVAPSV                                          G0088770
ISN       27        COMMON/RESPRO/KA,KC(55),PHI(55),DBCB(55),PCAPW(55),PCAPV(55)              G0088780
ISN       28        COMMON/PRM123/KRGP(55),KROP(55),KRWP(55),AKROG(55),AKROW(55)              G0088790
ISN       29        COMMON/CPLCPV/CPLWA(55),CPVWA(55),CPLOL(55),CPVOL(55),                    G0088800
                1                  CPLOS(55),CPVOS(55),CPLOW(55)                            G0088810
ISN       30        COMMON/MWEITS/MO,MWOIL,MSOL,MGP,RTMMAT,RTMOIL,RTMINT,RTMSOL               G0088820
ISN       31        COMMON/LNMOLD/XLOG10                                                      G0088830
ISN       32        COMMON/INJCND/RATEL,PSPECL,MOBGL,MOBWL,MOBOL,MOBTL,                       G0088840
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                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
                      1              AINJV,TSPECL,
                      2              RCOND(
ISN       33       COMMON/PRDCND/RATER,PSPECR,MOBGR,MOBWR,MOBOR,MOBTR,                    G0088850
                      1              PRODV,TSPECR,                                          G0088860
                      2              RCOND)                                                 G0088870
ISN       34       COMMON/ENHLPY/ENHLWA(55),ENHVWA(55),ENHLOS(55),ENHVOS(55),             G0088880
                      1              ENHLOL(55),ENHVOL(55),ENHLOH(55),                      G0088890
                      2              ENHWP(55),ENHOP(55),ENHVP(55),                         G0088900
                      3              ENHWPH,ENHWPH,ENHOPH,ENHVPH,ENHVPH                     G0088910
ISN       35       COMMON/TABLE1/TACTEM(12),TALMUO(12),TALMUW(12),TAMMUG(12),              G0088920
                      1              IENTTI(55),NENTTI                                      G0088930
ISN       36       COMMON/TABLE2/TABXN(8),TABUOR(8),IENTXN(55),NENTXN                      G0088940
ISN       37       COMMON/TABLE3/TABSM(16),TABKRM(16),TABKOM(16),TABPCM(16),               G0088950
                      1              IENTSM(55),NENTSM                                      G0088960
ISN       38       COMMON/TABLE4/TABSL(18),TABKRG(18),TABKOG(18),TABPCV(18),               G0088970
                      1              IENTSL(55),NENTSL                                      G0088980
ISN       39       COMMON/ERROR/ITABL                                                      G0088990
ISN       40       COMMON/BASICS/ZERO,HALF,ONE,TWO                                         G0089000
ISN       41       COMMON/DIMENS/NDIMNS,NX,NY,NOS,NRS,NRFN,NRFP                            G0089010
ISN       42       COMMON/TABLS1/NBLKS,NGRPS,JGRPOG(50),JAGPOF(9,16),                      G0089020
                      1              JBLK(55),JFPT(55)                                      G0089030
ISN       43       COMMON/TABL1A/LFRNT(55)                                                 G0089040
ISN       44       COMMON/BTBLS1/NBNDBS,JBNDOG(55),JBNDB(50),JBLKOB(28),JINTOB(28)         G0089050
ISN       45       COMMON/BTBL1A/LBNDOG(55),LBNDB(50)                                      G0089060
ISN       46       COMMON/SPEC4 /RCOND(28),INJECT(28)                                      G0089070
ISN       47       COMMON/BMOBS /MOBG(28),MOBW(28),MOBO(28),MOBT(28)                       G0089080
ISN       48       COMMON/GRAVTY/GX,GY,DENMSW(55),DENMSO(55),DENMSV(55),GRAVP(55)          G0089090
ISN       49       COMMON/TABLS2/NRLGS,JGRPOF(16),JRLG(55),JGRPOR(54),                     G0089100
                      1              JGPTNR(55),JTYFRN(55),JTYRFL(55),JRFLIM(55)            G0089110
                C                                                                         G0089120
                C     IF COORTR IS FALSE, CALL PROPTY EXACTLY ONCE.                       G0089130
                C     IF COORTR IS TRUE, THEN:                                            G0089140
                C        IF LFRNC IS FALSE, CALL PROPTY ONCE AT JGRPJ,                    G0089150
                C                           AND PERHAPS ONCE AT THE IMAGE.                G0089160
                C        IF LFRNC IS  TRUE, CALL PROPTY AT BOTH SIDES OF THE FRONT,       G0089170
                C                           AND PERHAPS AT THEIR IMAGES.                  G0089180
                C           BECAUSE THE INSIDE TEMPERATURE DEPENDS ON THE                 G0089190
                C           VAPOUR-LIQUID EQUILIBRIUM, WHEREAS THE OUTSIDE                G0089200
                C           TEMPERATURE DEPENDS ONLY ON THE TEMPERATURE COUPLING,         G0089210
                C           THE INSIDE TEMPERATURE MUST BE CALCULATED FIRST,              G0089220
                C           ASSUMING THAT LFRNC IS .TRUE.                                 G0089230
                C                                                                         G0089240
ISN       50          IF (.NOT.COORTR) CALL PROPTY(JGRPJ,JGRPJ,LCTNPH,0)                  G0089250
                C        I.E. CALL SUBROUTINE PROPTY(ISTART,IFINIS,LCTNPH,IJOB)           G0089260
                C                                                                         G0089270
ISN       52          IF (COORTR) THEN                                                    G0089280
ISN       53             LFICT=JTYRFL(JGRPJ).EQ.2                                         G0089290
ISN       54             LFRNC=JTYFRN(JGRPJ).EQ.3                                         G0089300
ISN       55             IF (LFRNC) THEN                                                  G0089310
ISN       56                JOTHFR=JGPTNR(JGRPJ)                                          G0089320
ISN       57                P(JOTHFR)=P(JGRPJ)                                            G0089330
ISN       58                IF (JTYFRN(JGRPJ).EQ.2) JG1=JGRPJ                             G0089340
ISN       60                IF (JTYFRN(JOTHFR).EQ.2) JG1=JOTHFR                           G0089350
ISN       62             ELSE                                                             G0089360
ISN       63                JG1=JGRPJ                                                     G0089370
ISN       64             END IF                                                           G0089380
                                                                                          G0089390
                                                                                          G0089400
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                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
                C
ISN       65          CALL PROPTY(JG1,JG1,LCTNPH,0)                                       G0089410
                C        I.E. CALL SUBROUTINE PROPTY(ISTART,IFINIS,LCTNPH,IJOB)           G0089420
ISN       66          IF (IERR.NE.0) RETURN                                               G0089430
                C                                                                         G0089440
ISN       68          IF (LFRNC) THEN                                                     G0089450
ISN       69             JOUTFR=JGPTNR(JG1)                                               G0089460
ISN       70             IF (DABS(T(JOUTFR)-T(JG1)).GT.0.1D0)                             G0089470
                      1     WRITE(6,45)JGRPJ,T(JOUTFR),T(JG1)                            G0089480
ISN       72       45    FORMAT(' SUPROP: NOT-SMALL FRONT COUPLING: T(',I3,               G0089490
                      1     ')  BEFORE:',F14.8,'  AFTER:',F14.8)                         G0089500
ISN       73             T(JOUTFR)=T(JG1)                                                 G0089510
                C                                                                         G0089520
ISN       74             CALL PROPTY(JOUTFR,JOUTFR,LCTNPH,0)                              G0089530
                C              I.E. CALL SUBROUTINE PROPTY(ISTART,IFINIS,LCTNPH,IJOB)     G0089540
ISN       75             IF (IERR.NE.0) RETURN                                            G0089550
                C                                                                         G0089560
ISN       77             END IF                                                           G0089570
                C                                                                         G0089580
ISN       78          IF (LFICT) THEN                                                     G0089590
ISN       79             JGIMAG=JRFLIM(JGRPJ)                                             G0089600
ISN       80             P(JGIMAG)=P(JGRPJ)                                               G0089610
ISN       81             T(JGIMAG)=T(JGRPJ)                                               G0089620
ISN       82             SGP(JGIMAG)=SGP(JGRPJ)                                           G0089630
ISN       83             SMP(JGIMAG)=SMP(JGRPJ)                                           G0089640
ISN       84             SOP(JGIMAG)=SOP(JGRPJ)                                           G0089650
ISN       85             DO 120 IC=1,3                                                    G0089660
ISN       86                XMOLE(IC,JGIMAG)=XMOLE(IC,JGRPJ)                             G0089670
ISN       87       120   CONTINUE                                                         G0089680
                C                                                                         G0089690
ISN       88             CALL PROPTY(JGIMAG,JGIMAG,LCTNPH,0)                              G0089700
                C              I.E. CALL SUBROUTINE PROPTY(ISTART,IFINIS,LCTNPH,IJOB)     G0089710
                C                                                                         G0089720
ISN       89             END IF                                                           G0089730
                C                                                                         G0089740
ISN       90          IF (LFICT.AND.LFRNC) THEN                                           G0089750
ISN       91             JOTHIM=JRFLIM(JOTHFR)                                            G0089760
ISN       92             P(JOTHIM)=P(JOTHFR)                                              G0089770
ISN       93             T(JOTHIM)=T(JOTHFR)                                              G0089780
ISN       94             SGP(JOTHIM)=SGP(JOTHFR)                                          G0089790
ISN       95             SMP(JOTHIM)=SMP(JOTHFR)                                          G0089800
ISN       96             SOP(JOTHIM)=SOP(JOTHFR)                                          G0089810
ISN       97             DO 400 IC=1,3                                                    G0089820
ISN       98                XMOLE(IC,JOTHIM)=XMOLE(IC,JOTHFR)                            G0089830
ISN       99       400   CONTINUE                                                         G0089840
                C                                                                         G0089850
ISN      100             CALL PROPTY(JOTHIM,JOTHIM,LCTNPH,0)                              G0089860
                C              I.E. CALL SUBROUTINE PROPTY(ISTART,IFINIS,LCTNPH,IJOB)     G0089870
                C                                                                         G0089880
ISN      101             END IF                                                           G0089890
                C                                                                         G0089900
ISN      102          END IF                                                              G0089910
                C                                                                         G0089920
ISN      103       RETURN                                                                G0089930
ISN      104       END                                                                   G0089940
                                                                                          G0089950
```

STATISTICS SOURCE STATEMENTS = 98, PROGRAM SIZE = 7500 BYTES, PROGRAM NAME = SUPROP PAGE: 182.

STATISTICS NO DIAGNOSTICS GENERATED.

SUPROP END OF COMPILATION 34 ******

OPTIONS IN EFFECT: NOLIST NOMAP NOXREF NOGOSTMT NODECK SOURCE TERM NOOBJECT FIXED NOTEST TRMFLG SRCFLG
NOSYM NORENT SDUMP AUTODBL(NONE) NOSXM IL
OPT(0) LANGLVL(77) NOFIPS FLAG(I) NAME(MAIN) LINECOUNT(60) CHARLEN(500)

```
                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
                C.CTFCFS                                                                G0089960
                CC                                                                      G0089970
                CC  SOO.  CALCULATE THOSE QUANTITIES RELATED TO FRNDIS.                 G0089980
                C                                                                       G0089990
ISN         1         SUBROUTINE CTFCFS(L2SYMM,JOSTA,JOFIN,NOS,NRS,NOMAX,NGRPMX,      G0090000
                     1                  DT,DCENDS,CENDIS,GX,GY,                         G0090010
                     2                  FRNDIS,DFRNDS,DFOMTH,DFOMTP,                    G0090020
                     3                  DFRDTH,FRFRTH,VFDOTN,XIRING,YIRING,             G0090030
                     4                  GRAVP)                                          G0090040
ISN         2         IMPLICIT DOUBLE PRECISION (A-H,K,O-Z)                           G0090050
                C                                                                       G0090060
ISN         3         DOUBLE PRECISION FRNDIS(NOMAX),DFRNDS(NOMAX)                    G0090070
ISN         4         DOUBLE PRECISION DFOMTH(NOMAX),DFOMTP(NOMAX)                    G0090080
ISN         5         DOUBLE PRECISION DFRDTH(NOMAX),FRFRTH(NOMAX),VFDOTN(NOMAX)      G0090090
ISN         6         DOUBLE PRECISION XIRING(NOMAX),YIRING(NOMAX)                    G0090100
ISN         7         DOUBLE PRECISION GRAVP(NGRPMX)                                  G0090110
ISN         8         LOGICAL L2SYMM,LMRAP,LCOND1,LCOND2                              G0090120
                CC                                                                      G0090130
                CC                                                                      G0090140
ISN         9         COMMON/BASICS/ZERO,HALF,ONE,TWO                                 G0090150
ISN        10         COMMON/IJTBIJ/IOFGRP(55),JOFGRP(55),JGRPIJ(36,24)               G0090160
ISN        11         COMMON/GLINEC/GLINEO(36),GLINER(24)                             G0090170
ISN        12         COMMON/TGRID /SINTHT(36),COSTHT(36),SINTHA(36),COSTHA(36),      G0090180
                     1           SINIPA(36),COSIPA(36)                                G0090190
                C                                                                       G0090200
                CC    INPUT SCALARS: JOSTA,JOFIN,L2SYMM,NOS,DCENDS,HALF,CENDIS,NRS,GX,GY G0090210
                CC    INPUT  ARRAYS: FRNDIS,DFOMTH,DFOMTP,GLINER                        G0090220
                CC   OUTPUT  ARRAYS: DFRDTH,FRFRTH,VFDOTN,XIRING,YIRING,GRAVP          G0090230
                CC                                                                      G0090240
ISN        13         LMRAP=JOFIN.LT.JOSTA                                            G0090250
ISN        14         DO 100 JO=1,NOS                                                 G0090260
ISN        15            LCOND1=(.NOT.LMRAP).AND.((JO.GE.JOSTA).AND.(JO.LE.JOFIN))    G0090270
ISN        16            LCOND2=      (LMRAP).AND.((JO.GE.JOSTA).OR.(JO.LE.JOFIN))    G0090280
                CCC            THE PURPOSE OF THIS TRICK IS TO MAKE IT POSSIBLE TO   G0090290
                CCC            DO CALCULATIONS FOR VALUES OF JO WHICH WRAP AROUND    G0090300
                CCC            THETA--PI (FOR EXAMPLE, FOR JO=NOS-1 NOS,1,2,3),      G0090310
                CCC            WITHOUT HAVING TO DO THE SAME CALCULATIONS IN         G0090320
                C              TWO SEPARATE DO LOOPS.                                G0090330
ISN        17            IF (LCOND1.OR.LCOND2) THEN                                   G0090340
ISN        18               IF (JO.EQ.1) THEN                                         G0090350
ISN        19                  IF (L2SYMM) JOM=1                                      G0090360
                C                 IF (L2SYMM) JOM=3  IS A POSSIBILITY.               G0090370
ISN        21                  IF (.NOT.L2SYMM) JOM=NOS                              G0090380
ISN        23                  ELSE                                                  G0090390
ISN        24                    JOM=JO-1                                            G0090400
ISN        25                  END IF                                                G0090410
                C                                                                     G0090420
ISN        26               IF (JO.EQ.NOS) THEN                                      G0090430
ISN        27                  IF (L2SYMM) JOP=NOS                                   G0090440
                C                 IF (L2SYMM) JOP=NOS-2 IS A POSSIBILITY.           G0090450
ISN        29                  IF (.NOT.L2SYMM) JOP=1                                G0090460
ISN        31                  ELSE                                                  G0090470
```

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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
ISN       32                    JOP=JO+1                                                        G0090480
ISN       33                  END IF                                                            G0090490
                C                                                                             G0090500
ISN       34                  DFRDTH(JO) = (DFOMTM(JO)*(FRNDIS(JO) -FRNDIS(JOM))              G0090510
                1                          + DFOMTP(JO)*(FRNDIS(JOP)-FRNDIS(JO))  )         G0090520
                C                THE PURPOSE OF DFOMTM AND DFOMTM IS TO HANDLE THE            G0090530
                C                "BOUNDARIES" PROPERLY (IF L2SYMM IS TRUE) WITHOUT            G0090540
                C                DIVIDING BY ZERO.                                            G0090550
ISN       35                  END IF                                                          G0090560
ISN       36          100 CONTINUE                                                            G0090570
                C                                                                             G0090580
ISN       37              IF (L2SYMM) THEN                                                    G0090590
ISN       38                IF (JOSTA.LE.1)   DFRDTH(1)  =-DFRDTH(3)                        G0090600
ISN       40                IF (JOFIN.GE.NOS) DFRDTH(NOS)=-DFRDTH(NOS-2)                    G0090610
ISN       42              END IF                                                            G0090620
                C                                                                             G0090630
                C             THE CALCULATION OF DFRDTH IS THE TRICKY PART OF THIS            G0090640
                C             SUBROUTINE, BECAUSE OF ALL THE SPECIAL CASES.                   G0090650
                C             THE CALCULATION OF FRFRTH, VFDOTN, XIRING, YIRING, AND GRAVP,   G0090660
                C             IN CONTRAST, IS RELATIVELY STRAIGHTFORWARD.                     G0090670
                C                                                                             G0090680
ISN       43              GRAVP(1)=-GY*CENDIS                                               G0090690
ISN       44              DO 200 JO=1,NOS                                                   G0090700
ISN       45                LCOND1=(.NOT.LHRAP).AND.((JO.GE.JOSTA).AND.(JO.LE.JOFIN))      G0090710
ISN       46                LCOND2=     (LHRAP).AND.((JO.GE.JOSTA). OR.(JO.LE.JOFIN))      G0090720
ISN       47                IF (LCOND1.OR.LCOND2) THEN                                      G0090730
                C                 EQUATION (II.30)                                          G0090740
ISN       48                  FRFRTH(JO)=DSQRT(FRNDIS(JO)**2+DFRDTH(JO)**2)                 G0090750
                C                 EQUATION (II.29)                                          G0090760
ISN       49                  TERM1=(FRNDIS(JO)-OFRNDS(JO))/DT                              G0090770
ISN       50                  TERM2=OCENDS*(SINTHT(JO)-DFRDTH(JO)*COSTHT(JO)/FRNDIS(JO))    G0090780
ISN       51                  VFDOTN(JO)=(FRNDIS(JO)/FRFRTH(JO))*(TERM1+TERM2)              G0090790
ISN       52                  XIRING(JO)=(HALF*GLINER(2)*FRNDIS(JO))*COSTHT(JO)             G0090800
ISN       53                  YIRING(JO)=(HALF*GLINER(2)*FRNDIS(JO))*SINTHT(JO)+CENDIS      G0090810
ISN       54                  XFACTR=FRNDIS(JO)*COSTHT(JO)                                  G0090820
ISN       55                  YFACTR=FRNDIS(JO)*SINTHT(JO)                                  G0090830
ISN       56                  DO 180 JR=2,NRS                                               G0090840
ISN       57                    JGRPJ=JGRPIJ(JO,JR)                                         G0090850
ISN       58                    XLOC=GLINER(JR)*XFACTR                                      G0090860
ISN       59                    YLOC=GLINER(JR)*YFACTR+CENDIS                               G0090870
ISN       60                    GRAVP(JGRPJ)=-(GX*XLOC+GY*YLOC)                             G0090880
ISN       61            180   CONTINUE                                                      G0090890
ISN       62                ENDIF                                                         G0090900
ISN       63          200 CONTINUE                                                        G0090910
                C                                                                         G0090920
ISN       64              RETURN                                                        G0090930
ISN       65              END                                                           G0090940
```

STATISTICS SOURCE STATEMENTS = 59, PROGRAM SIZE = 4492 BYTES. PROGRAM NAME = CTFCFS PAGE: 186.

STATISTICS NO DIAGNOSTICS GENERATED.

CTFCFS END OF COMPILATION 35 ******

OPTIONS IN EFFECT: NOLIST NOMAP NOXREF NOGOSTMT NODECK SOURCE TERM NOOBJECT FIXED NOTEST TRMFLG SRCFLG
NOSYM NORENT SDUMP AUTODBL(NONE) NOSXM IL
OPT(0) LANGLVL(77) NOFIPS FLAG(I) NAME(MAIN) LINECOUNT(60) CHARLEN(500)

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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
                C.EQCDCL                                                                  G0090950
                C                                                                         G0090960
                C  S00.  CALCULATE THE CODES CONTROLLING THE MATCHING CONDITIONS.         G0090970
                C                                                                         G0090980
ISN        1          SUBROUTINE EQCDCL(LEINIT,LOUTP,NCOMPS,NBALNS,                     G0090990
                1                    NOMAX,NGRPMX,NEDGMX,                               G0091000
                2                    VFDOTN,CONCL,CONCV,FLTMTO,                         G0091010
                3                    IEQCOD)                                            G0091020
ISN        2          IMPLICIT DOUBLE PRECISION (A-H,K,O-Z)                             G0091030
                C                                                                         G0091040
ISN        3          LOGICAL LEINIT,LOUTP                                              G0091050
ISN        4          DOUBLE PRECISION VFDOTN(NOMAX)                                    G0091060
ISN        5          DOUBLE PRECISION CONCL(NCOMPS,NGRPMX),CONCV(NCOMPS,NGRPMX)        G0091070
ISN        6          DOUBLE PRECISION FLTMTO(NBALNS,NEDGMX)                            G0091080
ISN        7          INTEGER IEQCOD(NBALNS,NGRPMX)                                     G0091090
                C                                                                         G0091100
                C                                                                         G0091110
ISN        8          COMMON/BASICS/ZERO,HALF,ONE,TWO                                   G0091120
ISN        9          COMMON/DIMENS/NDIMNS,NX,NY,NOS,NRS,NRFM,NRFP                      G0091130
ISN       10          COMMON/TABLS1/NBLKS,NGRPS,JGRPOG(50),JAGPOF(9,16),                G0091140
                1                 JBLK(55),JFPT(55)                                       G0091150
ISN       11          COMMON/EDTOF /JEDGOF(2,16),JPEDHO(16),JPEDVE(16)                  G0091160
ISN       12          COMMON/IJTBIJ/IOFGRP(55),JOFGRP(55),JGRPIJ(36,24)                 G0091170
ISN       13          COMMON/TABLS2/NRLGS,JGRPOF(16),JRLG(55),JGRPOR(54),               G0091180
                1                 JGPTNR(55),JTYFRM(55),JTYRFL(55),JRFLIM(55)             G0091190
                C                                                                         G0091200
                CCC  PAGE 1A                                                              G0091210
                CCC   INPUT SCALARS: NCOMPS,NBALNS,NOMAX,NGRPMX,NEDGMX                    G0091220
                CCC                                                                       G0091230
                CCC  PAGE 1B                                                              G0091240
                CCC   INPUT SCALARS: LEINIT,NGRPS                                         G0091250
                CCC   INPUT  ARRAY : JTYFRM                                               G0091260
                CCC  OUTPUT  ARRAY : IEQCOD                                               G0091270
                CCC                                                                       G0091280
                CCC  PAGE 2A                                                              G0091290
                CCC   INPUT SCALARS: NOS,NRFM,NRFP,LOUTP,ZERO                             G0091300
                CCC   INPUT  ARRAYS: VFDOTN,JGRPIJ,JFPT,JEDGOF,FLTMTO,CONCL,CONCV         G0091310
                CCC                                                                       G0091320
                CCC  PAGE 2B                                                              G0091330
                CCC  OUTPUT  ARRAY : IEQCOD                                               G0091340
                CCC                                                                       G0091350
                C                                                                         G0091360
ISN       14          IF (LEINIT) THEN                                                  G0091370
ISN       15            DO 150 JGRPJ=1,NGRPS                                            G0091380
ISN       16              DO 140 IBALN=1,NBALNS                                         G0091390
ISN       17                IEQCOD(IBALN,JGRPJ)=JTYFRM(JGRPJ)                           G0091400
ISN       18          140   CONTINUE                                                    G0091410
ISN       19          150 CONTINUE                                                      G0091420
ISN       20            END IF                                                          G0091430
                C                                                                         G0091440
ISN       21          IF (.NOT.LEINIT) THEN                                             G0091450
ISN       22            DO 250 JO=1,NOS                                                 G0091460
```

```
                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
ISN       23                VFDN=VFDOTN(JO)                                        G0091470
ISN       24                JGPINN=JGRPIJ(JO,NRFM)                                 G0091480
ISN       25                JGPOUT=JGRPIJ(JO,NRFP)                                 G0091490
ISN       26                JFP=JFPT(JGPINN)                                       G0091500
          C                    OR JFPT(JGPOUT); IT DOES NOT MATTER.                G0091510
ISN       27                JEDINN=JEDGOF(1,JFP)                                   G0091520
ISN       28                JEDOUT=JEDGOF(2,JFP)                                   G0091530
          C                    THE ENTHALPY MATCHING CONDITION SHOULD STAY          G0091540
          C                    ON THE INSIDE.                                      G0091550
ISN       29                NCSM1=NCOMPS-1                                         G0091560
ISN       30                DO 240 ICOMPO=1,NCSM1                                  G0091570
ISN       31                   ICOMPL=ICOMPO                                       G0091580
ISN       32                   ICOMPV=ICOMPO+NCOMPS                                G0091590
ISN       33                   FL1LIQ=FLTMTO(ICOMPL,JEDINN)-VFDN*CONCL(ICOMPO,JGPINN)  G0091600
ISN       34                   FL1VAP=FLTMTO(ICOMPV,JEDINN)-VFDN*CONCV(ICOMPO,JGPINN)  G0091610
ISN       35                   FL2LIQ=FLTMTO(ICOMPL,JEDOUT)-VFDN*CONCL(ICOMPO,JGPOUT)  G0091620
ISN       36                   FL2VAP=FLTMTO(ICOMPV,JEDOUT)-VFDN*CONCV(ICOMPO,JGPOUT)  G0091630
ISN       37                   FL1TOT=FL1LIQ+FL1VAP                                G0091640
ISN       38                   FL2TOT=FL2LIQ+FL2VAP                                G0091650
          C       DELETED   IF (LOUTP.AND.((FL1TOT*FL2TOT).LT.ZERO))               G0091660
          C       DELETED    WRITE(6,201)FL1TOT,FL2TOT,ICOMPO,JO                    G0091670
          C 201   DELETED    FORMAT('  ******EQCDCL: THE FLOWS ',D13.5,            G0091680
          C     1 DELETED           ' AND ',D13.5,' OF COMPONENT #',I2/            G0091690
          C     2 DELETED           '  ******EQCDCL: AT FRONT POINT #',I3,         G0091700
          C     3 DELETED           ' ARE UNFORTUNATELY IN OPPOSITE DIRECTIONS.'/  G0091710
          C     4 DELETED           '  ******EQCDCL: NEVERTHELESS, FULL SPEED AHEAD.'  G0091720
ISN       39                   FLOTOT=FL1TOT+FL2TOT                                G0091730
          C                         A CODE OF 2 MEANS USE THE MATCHING CONDITIONS.  G0091740
          C                         A CODE OF 3 MEANS USE THE TRANSPORT EQUATIONS.  G0091750
          C                         USE THE MATCHING CONDITIONS ON THE DOWNSTREAM SIDE.G0091760
          C                         USE THE TRANSPORT EQUATIONS ON THE   UPSTREAM SIDE.G0091770
ISN       40                   IF (FLOTOT.GE.0) THEN                               G0091780
ISN       41                      IEQCOD(ICOMPL,JGPINN)=3                          G0091790
ISN       42                      IEQCOD(ICOMPV,JGPINN)=3                          G0091800
ISN       43                      IEQCOD(ICOMPL,JGPOUT)=2                          G0091810
ISN       44                      IEQCOD(ICOMPV,JGPOUT)=2                          G0091820
ISN       45                   END IF                                              G0091830
ISN       46                   IF (FLOTOT.LT.ZERO) THEN                            G0091840
ISN       47                      IEQCOD(ICOMPL,JGPINN)=2                          G0091850
ISN       48                      IEQCOD(ICOMPV,JGPINN)=2                          G0091860
ISN       49                      IEQCOD(ICOMPL,JGPOUT)=3                          G0091870
ISN       50                      IEQCOD(ICOMPV,JGPOUT)=3                          G0091880
ISN       51                   END IF                                              G0091890
ISN       52             240   CONTINUE                                            G0091900
          C       DEL      IF (LOUTP) WRITE(6,202)JO,(IEQCOD(IC,JGPINN),IC=1,NCSM1),  G0091910
          C     1 DEL                                IEQCOD(IC,JGPOUT),IC=1,NCSM1)  G0091920
          C 202   DEL      FORMAT(' EQC',I2,4X,4I2,4X,4I2)                         G0091930
ISN       53             250   CONTINUE                                            G0091940
ISN       54                   END IF                                              G0091950
          C                                                                        G0091960
ISN       55                RETURN                                                 G0091970
ISN       56                END                                                    G0091980

*STATISTICS*   SOURCE STATEMENTS = 56, PROGRAM SIZE = 3984 BYTES, PROGRAM NAME = EQCDCL    PAGE:  188.

*STATISTICS*    NO DIAGNOSTICS GENERATED.
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EQCDCL END OF COMPILATION 36 ******

OPTIONS IN EFFECT: NOLIST NOMAP NOXREF NOGOSTMT NODECK SOURCE TERM NOOBJECT FIXED NOTEST TRMFLG SRCFLG
NOSYM NORENT SDUMP AUTODBL(NONE) NOSXM IL
OPT(0) LANGLVL(77) NOFIPS FLAG(I) NAME(MAIN) LINECOUNT(60) CHARLEN(500)

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                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
                C.GRAVCL                                                                G0091990
                C                                                                       G0092000
                C  S00.  CALCULATE GRAVP (WHICH DEPENDS ON FRNDIS).                     G0092010
                C                                                                       G0092020
ISN         1         SUBROUTINE GRAVCL(L2SYMM,JOSTA,JOFIN,NGRPMX,                      G0092030
                     1                  GX,GY,GRAVP)                                    G0092040
ISN         2         IMPLICIT DOUBLE PRECISION (A-H,K,O-Z)                           G0092050
                C                                                                       G0092060
ISN         3         DOUBLE PRECISION GRAVP(NGRPMX)                                  G0092070
ISN         4         LOGICAL L2SYMM                                                  G0092080
                C                                                                       G0092090
                C                                                                       G0092100
ISN         5         COMMON/DIMENS/NDIMNS,NX,NY,NOS,NRS,NRFM,NRFP                    G0092110
ISN         6         COMMON/IJTBIJ/IOFGRP(55),JOFGRP(55),JGRPIJ(36,24)               G0092120
ISN         7         COMMON/GLINEC/GLINEO(36),GLINER(24)                             G0092130
ISN         8         COMMON/TGRID /SINTHT(36),COSTHT(36),SINTHA(36),COSTHA(36),      G0092140
                     1             SINIMA(36),COSIMA(36),SINIPA(36),COSIPA(36),     G0092150
ISN         9         COMMON/FRNTCF/DCENDS,CENDIS,FRNDIS(36),DFROTH(36),FRFRTH(36),   G0092160
                     1             VFDOTH(36),XIRING(36),YIRING(36)                  G0092170
                C                                                                       G0092180
                C  INPUT SCALARS: JOSTA,JOFIN,NRS,CENDIS,GX,GY                         G0092190
                C  INPUT  ARRAYS: FRNDIS,COSTHT,SINTHT,JGRPIJ,GLINER                   G0092200
                C OUTPUT  ARRAYS: GRAVP                                                 G0092210
                C                                                                       G0092220
                C                                                                       G0092230
                C         CALCULATE GRAVP, THE GRAVITATIONAL POTENTIAL.                 G0092240
                C                                                                       G0092250
ISN         10        DO 140 JO=JOSTA,JOFIN                                           G0092260
ISN         11           XFACTR=FRNDIS(JO)*COSTHT(JO)                                 G0092270
ISN         12           YFACTR=FRNDIS(JO)*SINTHT(JO)                                 G0092280
ISN         13           DO 130 JR=2,NRS                                              G0092290
ISN         14              JGRPJ=JGRPIJ(JO,JR)                                       G0092300
ISN         15              XLOC=GLINER(JR)*XFACTR                                    G0092310
ISN         16              YLOC=GLINER(JR)*YFACTR+CENDIS                             G0092320
ISN         17              GRAVP(JGRPJ)=-(GX*XLOC+GY*YLOC)                           G0092330
ISN         18     130    CONTINUE                                                    G0092340
ISN         19     140 CONTINUE                                                       G0092350
                C                                                                       G0092360
ISN         20        GRAVP(1)=-GY*CENDIS                                             G0092370
                C                                                                       G0092380
ISN         21        RETURN                                                          G0092390
ISN         22        END                                                             G0092400
```

STATISTICS SOURCE STATEMENTS = 22, PROGRAM SIZE = 1952 BYTES, PROGRAM NAME = GRAVCL PAGE: 191.

STATISTICS NO DIAGNOSTICS GENERATED.

GRAVCL END OF COMPILATION 37 ******

OPTIONS IN EFFECT: NOLIST NOMAP NOXREF NOGOSTMT NODECK SOURCE TERM NOOBJECT FIXED NOTEST TRMFLG SRCFLG
NOSYM NORENT SDUMP AUTODBL(NONE) NOSXM IL
OPT(0) LANGLVL(77) NOFIPS FLAG(I) NAME(MAIN) LINECOUNT(60) CHARLEN(500)

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                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
                C.ACUMCL                                                                G0092410
                C                                                                       G0092420
                C  S00.  CALCULATE THE ACCUMULATION FOR EACH COMPONENT                  G0092430
                C        BOTH FOR EACH GRID BLOCK AND FOR EACH FRONT GROUP.              G0092440
                C                                                                       G0092450
ISN         1         SUBROUTINE ACUMCL(ALGRPS,INITLZ,TEST,                           G0092460
                     1                  NFPTMX,NGRPMX,MATRMX,NCOMPS,NBALNS,          G0092470
                     2                  NCALCS,GRPLIS,ENHCF,VOLCF                    G0092480
                     3                  CONCL,CONCV,SCAREA,ACCUM,ACUMF)              G0092490
                C        THE PARAMETER ALGRPS WAS RESERVED FOR FUTURE USE, IS NOW USED. G0092500
ISN         2         IMPLICIT DOUBLE PRECISION (A-H,K,O-Z)                           G0092510
                C                                                                       G0092520
ISN         3         LOGICAL ALGRPS,INITLZ,TEST,LCALCR,LCALCF,LCALC(55)              G0092530
ISN         4         INTEGER GRPLIS(NCALCS)                                          G0092540
ISN         5         DOUBLE PRECISION SCAREA(5,NFPTMX)                               G0092550
ISN         6         DOUBLE PRECISION CONCL(NCOMPS,NGRPMX),CONCV(NCOMPS,NGRPMX)      G0092560
ISN         7         DOUBLE PRECISION ACCUM(NBALNS,NGRPMX)                           G0092570
ISN         8         DOUBLE PRECISION ACUMF(NBALNS,NFPTMX)                           G0092580
ISN         9         DOUBLE PRECISION ENHCF(NCOMPS,NGRPMX),VOLCF(NCOMPS,NGRPMX)      G0092590
ISN         10        INTEGER CNCLIS(55)                                              G0092600
ISN         11        DOUBLE PRECISION MATCHL,MATCHV                                  G0092610
ISN         12        CHARACTER*6 EQCD                                                G0092620
                C                                                                       G0092630
ISN         13        LOGICAL COORTR,TRACKF,OVTAKE,DATAFR,RESTRT                      G0092640
ISN         14        DOUBLE PRECISION LAMBDA                                         G0092650
ISN         15        CHARACTER*4 CYLN,SPHR,CSYSTM                                    G0092660
ISN         16        CHARACTER*6 TRANSP,MATCHC,BOTH,NEITHR,EQTYPE                    G0092670
                C                                                                       G0092680
ISN         17        COMMON/PVAPOR/PHAT(55),POIL(55),PSOL(55),DPHAT(55),DPOIL(55),   G0092690
                     1          DPSOL(55),DPDT(55),YMOLE(4,55),YO(55),YV(55),YS(55)  G0092700
ISN         18        COMMON/GRIPRO/DT,DXFRNT,DISXN,DX(57),DISTX(58),MFRONT,NBLOKS,   G0092710
                     1          NG,NJAY,COORTR,TRACKF,OVTAKE,DATAFR,RESTRT           G0092720
ISN         19        COMMON/STATEV/SHP(55),SGP(55),SOP(55),T(55),P(55),              G0092730
                     1          XMOLE(3,55),XO(55),XSOL(55),XN(55)                   G0092740
ISN         20        COMMON/FLUPRO/DHP(55),DOP(55),DGP(55),UHP(55),UOP(55),UGP(55),  G0092750
                     1          CHP(55),COP(55),CGP(55),KO(55),KSOL(55),LAMBDA(55),  G0092760
                     2          DENSOL(55),DENSOH(55),DENSOS(55),                    G0092770
                     3          DFSPCH(55),DFSPCO(55),DFSPCV(55),GASCON              G0092780
ISN         21        COMMON/RESPRO/KA,KC(55),PHI(55),DBCB(55),PCAPH(55),PCAPV(55)    G0092790
ISN         22        COMMON/ENHLPY/ENHLHA(55),ENHVHA(55),ENHLOS(55),ENHVOS(55),      G0092800
                     1          ENHLOL(55),ENHVOL(55),ENHLOH(55),                    G0092810
                     2          ENHHP(55) ,ENHOP(55) ,ENHVP(55)                      G0092820
                     3          ENHOPH,ENHHPH,ENHOPH,ENHOPH,ENHVHH,ENHVPH            G0092830
ISN         23        COMMON/BASICS/ZERO,HALF,ONE,TWO                                 G0092840
ISN         24        COMMON/IBASCS/NULL                                              G0092850
ISN         25        COMMON/TABLS1/NBLKS,NGRPS,JGRPOG(50),JAGPOF(9,16),              G0092860
                     1          JBLK(55),JEPT(55)                                    G0092870
ISN         26        COMMON/OLDFT1/OCONCL(5,55),OCONCV(5,55)                         G0092880
ISN         27        COMMON/ADJACN/IFORML,JUPGRP(16),JADJAC(4,55)                    G0092890
ISN         28        COMMON/IBCONS/IHEQN,IMBAL,IVEQN,IVBAL                           G0092900
ISN         29        COMMON/CORSYS/CYLN,SPHR,CSYSTM                                  G0092910
ISN         30        COMMON/EQNTYP/TRANSP,MATCHC,BOTH,NEITHR,EQTYPE(10,3)            G0092920
```

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                *....*....1.....2.....3.....4.....5.....6.....7.*.....8
ISN       31          COMMON/EQNTCD/IEQCOD(10,55)                                   G0093930
ISN       32          COMMON/IJIBIJ/IOFGRP(55),JOFGRP(55),JGRPIJ(36,24)             G0093940
ISN       33          COMMON/TABLS2/NRLGS,JGRPOF(16),JRLG(55),JGRPOR(54),           G0093950
                     1            JGPTNR(55),JTYFRN(55),JTYRFL(55),JRFLIM(55)     G0093960
ISN       34          COMMON/GLINEC/GLINEQ(36),GLINER(24)                           G0093970
ISN       35          COMMON/TGRID /SINTHT(36),COSTHT(36),SINTHA(36),COSTHA(36),    G0093980
                     1            SINIHA(36),COSIHA(36),SINIPA(36),COSIPA(36)     G0093990
ISN       36          COMMON/DGRID /DTHTAH(36),DTHTAP(36),DOPHHH(36),DTHETA(36),    G0094000
                     1            DFOHTH(36),DFOHTP(36),                          G0094010
                     2            DRPHHH(24),DRADH1(24),DRADP1(24)                G0094020
ISN       37          COMMON/FRNTCF/DCENDS,CENDIS,FRNDIS(36),DFRDTH(36),FRFRTH(36), G0094030
                     1            VFDOTN(36),XIRING(36),YIRING(36)                G0094040
ISN       38          COMMON/OFRNCF/OFRNDS(36)                                      G0094050
C                                                                                   G0094060
C                   PAGE 3A                                                         G0094070
C                    INPUT SCALARS: NGRPS,NCALCS                                    G0094080
C                    INPUT  ARRAYS: LCALC,GRPLIS,CNCLIS,JADJAC                      G0094090
C                                                                                   G0094100
C                   PAGE 2A (OLD)                                                   G0094110
C                    INPUT SCALARS: ZERO,ONE                                        G0094120
C                    INPUT  ARRAYS: PHI,SMP,DMP,SOP,DOP,SGP,DGP,ENHMP,ENHOP,ENHVP,  G0094130
C                                   DBCB,T,XMOLE,YMOLE                              G0094140
C                                                                                   G0094150
C                   PAGE 2A (EXTRA)                                                 G0094160
C                   OUTPUT  ARRAYS: CONCL,CONCV                                     G0094170
C                                                                                   G0094180
C                   PAGE 3B                                                         G0094190
C                    INPUT SCALARS: INITLZ,NULL,NCOMPS                              G0094200
C                    INPUT  ARRAYS: IOFGRP,JOFGRP,JTYFRN,OCONCL,OCONCV              G0094210
C                   OUTPUT  ARRAY : ACCUM                                           G0094220
C                                                                                   G0094230
C                   PAGE 3C                                                         G0094240
C                    INPUT SCALARS: CSYSTM,CYLN,SPHR,DCENDS,DT                      G0094250
C                    INPUT  ARRAYS: COSTHT,GLINER,FRNDIS,DOPHHH,OFRNDS,SINTHT,DFRDTH,G0094260
C                                   DRPHHH                                          G0094270
C                                                                                   G0094280
C                   PAGE 4A                                                         G0094290
C                    INPUT SCALARS: TRANSP,MATCHC                                   G0094300
C                    INPUT  ARRAYS: EQTYPE,VFDOTN                                   G0094310
C                                                                                   G0094320
ISN       39          DO 120 JGRPJ=1,NGRPS                                          G0094330
ISN       40            LCALC(JGRPJ)=.FALSE.                                        G0094340
ISN       41      120 CONTINUE                                                      G0094350
ISN       42          IF (ALGRPS) THEN                                              G0094360
ISN       43            DO 130 JGRPJ=1,NGRPS                                        G0094370
ISN       44              LCALC (JGRPJ)=.TRUE.                                      G0094380
ISN       45              GRPLIS(JGRPJ)=JGRPJ                                       G0094390
ISN       46      130     CONTINUE                                                  G0094400
ISN       47            END IF                                                      G0094410
ISN       48          ICALC2=0                                                      G0094420
C                       CALCULATE CNCLIS.                                           G0094430
C                       CNCLIS CONSISTS OF GRPLIS, PLUS ALL "DIRECT" NEIGHBOURS.    G0094440
C                       PRECAUTIONS ARE TAKEN SO THAT CNCLIS                        G0094450
C                       DOES NOT HAVE DUPLICATES.                                   G0094460
ISN       49          DO 140 ICALC=1,NCALCS                                         G0094470
ISN       50            JGRPJ=GRPLIS(ICALC)                                         G0094480
```



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                *....*....1.....2.....3.....4.....5.....6.....7.*.....8
ISN       51            LCALC(JGRPJ)=.TRUE.                                       G0094490
ISN       52            ICALC2=ICALC2+1                                           G0094500
ISN       53            CNCLIS(ICALC2)=JGRPJ                                      G0094510
ISN       54      140 CONTINUE                                                    G0094520
ISN       55          IF (.NOT.ALGRPS) THEN                                       G0094530
ISN       56            DO 180 ICALC=1,NCALCS                                     G0094540
ISN       57              JGRPJ=GRPLIS(ICALC)                                     G0094550
ISN       58              DO 160 ISIDE=1,4                                        G0094560
ISN       59                JGRP2=JADJAC(ISIDE,JGRPJ)                             G0094570
ISN       60                IF (JGRP2.GT.NULL) THEN                               G0094580
ISN       61                  IF (.NOT.LCALC(JGRP2)) THEN                         G0094590
ISN       62                    LCALC(JGRP2)=.TRUE.                               G0094600
ISN       63                    ICALC2=ICALC2+1                                   G0094610
ISN       64                    CNCLIS(ICALC2)=JGRP2                              G0094620
ISN       65                  END IF                                              G0094630
ISN       66                END IF                                                G0094640
ISN       67      160       CONTINUE                                              G0094650
ISN       68      180     CONTINUE                                                G0094660
ISN       69            END IF                                                    G0094670
ISN       70          NCLCS2=ICALC2                                               G0094680
C                                                                                 G0094690
C                       CALCULATE CONCL,CONCV WHERE NEEDED.                       G0094700
C                                                                                 G0094710
ISN       71          DO 200 ICALC2=1,NCLCS2                                      G0094720
ISN       72            JGRPJ=CNCLIS(ICALC2)                                      G0094730
ISN       73            AMTMAT=PHI(JGRPJ)*SMP(JGRPJ)*DMP(JGRPJ)                   G0094740
ISN       74            AMTHCB=PHI(JGRPJ)*SOP(JGRPJ)*DOP(JGRPJ)                   G0094750
ISN       75            AMTVAP=PHI(JGRPJ)*SGP(JGRPJ)*DGP(JGRPJ)                   G0094760
ISN       76            CONCL(1,JGRPJ) = AMTMAT                                   G0094770
ISN       77            CONCL(2,JGRPJ) = AMTHCB*XMOLE(1,JGRPJ)                    G0094780
ISN       78            CONCL(3,JGRPJ) = AMTHCB*XMOLE(2,JGRPJ)                    G0094790
ISN       79            CONCL(4,JGRPJ) = AMTHCB*XMOLE(3,JGRPJ)                    G0094800
ISN       80            CONCL(5,JGRPJ) = AMTMAT*ENHMP(JGRPJ) + AMTHCB*ENHOP(JGRPJ)G0094810
                     1                   + (ONE-PHI(JGRPJ))*DBCB(JGRPJ)*T(JGRPJ)  G0094820
ISN       81            CONCV(1,JGRPJ) = AMTVAP*YMOLE(4,JGRPJ)                    G0094830
ISN       82            CONCV(2,JGRPJ) = AMTVAP*YMOLE(1,JGRPJ)                    G0094840
ISN       83            CONCV(3,JGRPJ) = AMTVAP*YMOLE(2,JGRPJ)                    G0094850
ISN       84            CONCV(4,JGRPJ) = ZERO                                     G0094860
ISN       85            CONCV(5,JGRPJ) = AMTVAP*ENHVP(JGRPJ)                      G0094870
ISN       86      200 CONTINUE                                                    G0094880
C                                                                                 G0094890
C                       CALCULATE ACCUM (ASSUMING INITLZ IS .FALSE.).             G0094900
C                                                                                 G0094910
ISN       87          IF (.NOT.INITLZ) THEN                                       G0094920
ISN       88            DO 300 ICALC=1,NCALCS                                     G0094930
ISN       89              JGRPJ=GRPLIS(ICALC)                                     G0094940
ISN       90              IF (JGRPJ.EQ.1) THEN                                    G0094950
C                           THE CENTRE GRID BLOCK REQUIRES SPECIAL TREATMENT.     G0094960
ISN       91                DO 210 ICOMPO=1,NCOMPS                                G0094970
ISN       92                  ICOMPL=ICOMPO                                       G0094980
ISN       93                  ICOMPV=ICOMPO+NCOMPS                                G0094990
ISN       94                  ACCUM(ICOMPL,1)=CONCL(ICOMPO,1)-OCONCL(ICOMPO,1)    G0095000
ISN       95                  ACCUM(ICOMPV,1)=CONCV(ICOMPO,1)-OCONCV(ICOMPO,1)    G0095010
ISN       96      210       CONTINUE                                              G0095020
ISN       97              END IF                                                  G0095030
C                           "DEFINE" ACCUM IF GROUP IS FICTITIOUS.                G0095040
```

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                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
ISN      98           IF (JTYRFL(JGRPJ).EQ.4) THEN                                    GD094050
ISN      99              DO 212 ICOMPO=1,NCOMPS                                       GD094060
ISN     100                 ACCUM(ICOMPO,JGRPJ)=ZERO                                  GD094070
ISN     101     212      CONTINUE                                                     GD094080
ISN     102           END IF                                                         GD094090
ISN     103           IF (JGRPJ.GT.1.AND.JTYRFL(JGRPJ).NE.4) THEN                    GD094100
                C            IE, DON'T DO THIS IF THE GROUP IS FICTITIOUS.
ISN     104              I=IOFGRP(JGRPJ)                                            GD094110
ISN     105              J=JOFGRP(JGRPJ)                                            GD094120
ISN     106              JGRPIP=JADJAC(1,JGRPJ)                                     GD094130
ISN     107              JGRPIM=JADJAC(3,JGRPJ)                                     GD094140
ISN     108              JGRPJP=JADJAC(4,JGRPJ)                                     GD094150
ISN     109              JGRPJM=JADJAC(2,JGRPJ)                                     GD094160
ISN     110              IF (JGRPIP.EQ.NULL) JGRPIP=JGRPJ                           GD094170
ISN     112              IF (JGRPIM.EQ.NULL) JGRPIM=JGRPJ                           GD094180
ISN     114              IF (JGRPJP.EQ.NULL) JGRPJP=JGRPJ                           GD094190
ISN     116              IF (JGRPJM.EQ.NULL) JGRPJM=JGRPJ                           GD094200
ISN     118              JTYFRJ=JTYFRN(JGRPJ)                                       GD094210
ISN     119              IF (JTYFRJ.EQ.2) THEN                                      GD094220
ISN     120                 JGRPFP=JGRPJP                                           GD094230
ISN     121                 JGRPFM=JGRPJ                                            GD094240
ISN     122                 JGRPJP=JGRPJ                                            GD094250
                C                THE RESULT OF THESE STATEMENTS:                    GD094260
                C                                  JGRPJ                            GD094270
                C                                  JGRPFM  JGRPFP                   GD094280
ISN     123                                JGRPJM  JGRPJP                           GD094290
ISN     124              END IF                                                     GD094300
ISN     125              IF (JTYFRJ.EQ.3) THEN                                      GD094310
ISN     126                 JGRPFM=JGRPJM                                           GD094320
ISN     127                 JGRPFP=JGRPJ                                            GD094330
                            JGRPJM=JGRPJ                                           GD094340
                C                THE RESULT OF THESE STATEMENTS:                    GD094350
                C                                  JGRPJ                           GD094360
                C                          JGRPFM  JGRPFP                          GD094370
ISN     128                                JGRPJM  JGRPJP                          GD094380
                              END IF                                               GD094390
ISN     129           C                                                            GD094400
ISN     130           C  IF (CSYSTM.EQ.CYLN) THEN                                  GD094410
                              EQUATION (II.21)                                     GD094420
                              COEFF2=(DT*DCENDS)*(COSTHT(I)/                       GD094430
     1                                           (GLINER(J)*FRNDIS(I)) )           GD094440
ISN     131                   COEF3A=GLINER(J)*(FRNDIS(I)-OFRNDS(I))               GD094450
ISN     132                   COEF3B=(DT*DCENDS)*( SINTHT(I)                       GD094460
     1                                            -OFRDTH(I)*COSTHT(I)/FRNDIS(I)  )GD094470
ISN     133                   COEFF3=(ONE/FRNDIS(I))*(COEF3A+COEF3B)               GD094480
ISN     134                 END IF                                                 GD094490
ISN     135           C                                                            GD094500
ISN     136           C  IF (CSYSTM.EQ.SPHR) THEN                                  GD094510
                              EQUATION (II.21)                                     GD094520
                              COEFF2=(DT*DCENDS)*(COSTHT(I)/                       GD094530
     1                                           (GLINER(J)*FRNDIS(I)) )           GD094540
ISN     137                   COEF3A=GLINER(J)*(FRNDIS(I)-OFRNDS(I))               GD094550
ISN     138                   COEF3B=(DT*DCENDS)*( SINTHT(I)                       GD094560
     1                                            -OFRDTH(I)*COSTHT(I)/FRNDIS(I)  )GD094570
ISN     139                   COEFF3=(ONE/FRNDIS(I))*(COEF3A+COEF3B)               GD094580
ISN     140                 END IF                                                 GD094590
                                                                                   GD094600
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                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
                C
ISN     141           DO 220 ICOMPO=1,NCOMPS                                       GD094610
ISN     142            ICOMPL=ICOMPO                                               GD094620
ISN     143            ICOMPV=ICOMPO+NCOMPS                                        GD094630
ISN     144            ACCUM(ICOMPL,JGRPJ)=ZERO                                    GD094640
ISN     145            ACCUM(ICOMPV,JGRPJ)=ZERO                                    GD094650
ISN     146            EQCD=EQTYPE(ICOMPO,IEQCOD(ICOMPO,JGRPJ))                    GD094660
                C                                                                  GD094670
ISN     147           IF (EQCD.EQ.TRANSP.OR.EQCD.EQ.BOTH) THEN                     GD094680
                C             USE THE REGULAR TRANSPORT EQUATIONS (II.21).         GD094690
ISN     148             TERM1L=CONCL(ICOMPO,JGRPJ)-OCONCL(ICOMPO,JGRPJ)            GD094700
ISN     149             TERM1V=CONCV(ICOMPO,JGRPJ)-OCONCV(ICOMPO,JGRPJ)            GD094710
                C                THE BASIC RULE FOR T2L, T2V, T3L, AND T3V:        GD094720
                C                NEVER SUBTRACT NEIGHBOURING                       GD094730
                C                CONCENTRATIONS  FROM THE BALANCES,                GD094740
                C                (I.E. TERM1L+TERM1V).                             GD094750
                C                INSTEAD, ADD THEM TO THE BALANCES.                GD094760
                C                ALTHOUGH UPSTREAM DIFFERENCING DOES NOT WORK,     GD094770
                C                THE HARMONIC MEAN METHOD ALSO OBEYS THIS PRINCIPLE.GD094780
                C                                                                  GD094790
                C             COMPUTE T2L AND T2V,                                 GD094800
                C             GRADML: GRADIENT - MINUS SIDE - LIQUID               GD094810
                C             GRADMV: GRADIENT - MINUS SIDE - VAPOUR               GD094820
                C             GRADPL: GRADIENT -  PLUS SIDE - LIQUID               GD094830
                C             GRADPV: GRADIENT -  PLUS SIDE - VAPOUR               GD094840
ISN     150             JGRPII=JGRPJ                                               GD094850
ISN     151             GRADML=(CONCL(ICOMPO,JGRPII)                               GD094860
     1                         -CONCL(ICOMPO,JGRPIM))/DTHTAM(I)                    GD094870
ISN     152             GRADMV=(CONCV(ICOMPO,JGRPII)                               GD094880
     1                         -CONCV(ICOMPO,JGRPIM))/DTHTAM(I)                    GD094890
ISN     153             GRADPL=(CONCL(ICOMPO,JGRPIP)                               GD094900
     1                         -CONCL(ICOMPO,JGRPII))/DTHTAP(I)                    GD094910
ISN     154             GRADPV=(CONCV(ICOMPO,JGRPIP)                               GD094920
     1                         -CONCV(ICOMPO,JGRPII))/DTHTAP(I)                    GD094930
                C             HARMONIC MEANS:                                      GD094940
ISN     155             PRODL=TMO*(GRADML*GRADPL)                                  GD094950
ISN     156             IF (PRODL.GT.ZERO) T2L=COEFF2*PRODL/(GRADML+GRADPL)        GD094960
ISN     158             IF (PRODL.LE.ZERO) T2L=ZERO                                GD094970
ISN     160             PRODV=TMO*(GRADMV*GRADPV)                                  GD094980
ISN     161             IF (PRODV.GT.ZERO) T2V=COEFF2*PRODV/(GRADMV+GRADPV)        GD094990
ISN     163             IF (PRODV.LE.ZERO) T2V=ZERO                                GD095000
                                                                                   GD095010
                C             COMPUTE T3L AND T3V,                                 GD095020
                C             GRADML: GRADIENT - MINUS SIDE - LIQUID               GD095030
                C             GRADMV: GRADIENT - MINUS SIDE - VAPOUR               GD095040
                C             GRADPL: GRADIENT -  PLUS SIDE - LIQUID               GD095050
                C             GRADPV: GRADIENT -  PLUS SIDE - VAPOUR               GD095060
ISN     165             JGRPJJ=JGRPJ                                               GD095070
ISN     166             IF (DRADM1(J).EQ.ZERO) THEN                                GD095080
ISN     167               GRADML=ZERO                                              GD095090
ISN     168               GRADMV=ZERO                                              GD095100
ISN     169             ELSE                                                       GD095110
ISN     170               GRADML=(CONCL(ICOMPO,JGRPJJ)                             GD095120
     1                         -CONCL(ICOMPO,JGRPJM))/DRADM1(J)                    GD095130
ISN     171               GRADMV=(CONCV(ICOMPO,JGRPJJ)                             GD095140
     1                         -CONCV(ICOMPO,JGRPJM))/DRADM1(J)                    GD095150
                                                                                   GD095160
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                 *....*...1.........2.........3.........4.........5.........6.........7.*.......8
ISN      172                    END IF                                                          G0095170
ISN      173                  IF (DRADP1(J).EQ.ZERO) THEN                                       G0095180
ISN      174                     GRADPL=ZERO                                                    G0095190
ISN      175                     GRADPV=ZERO                                                    G0095200
ISN      176                   ELSE                                                           G0095210
ISN      177                     GRADPL=(CONCL(ICOMPO,JGRPJP)                                 G0095220
         1                              -CONCL(ICOMPO,JGRPJJ))/DRADP1(J)                      G0095230
ISN      178                     GRADPV=(CONCV(ICOMPO,JGRPJP)                                 G0095240
         1                              -CONCV(ICOMPO,JGRPJJ))/DRADP1(J)                      G0095250
ISN      179                   END IF                                                         G0095260
ISN      180                  IF (JTYFRN(JGRPJ).NE.1) THEN                                    G0095270
ISN      181                     IF (JTYFRN(JGRPJ).EQ.2) THEN                                 G0095280
ISN      182                        T3L=COEFF3*GRADML                                         G0095290
ISN      183                        T3V=COEFF3*GRADMV                                         G0095300
ISN      184                     END IF                                                       G0095310
ISN      185                     IF (JTYFRN(JGRPJ).EQ.3) THEN                                 G0095320
ISN      186                        T3L=COEFF3*GRADPL                                         G0095330
ISN      187                        T3V=COEFF3*GRADPV                                         G0095340
ISN      188                     END IF                                                       G0095350
ISN      189                   ELSE                                                           G0095360
         C                          HARMONIC MEANS:                                         G0095370
ISN      190                     PRODL=TWO*(GRADML*GRADPL)                                    G0095380
ISN      191                     IF (PRODL.GT.ZERO) T3L=COEFF3*PRODL/(GRADML+GRADPL)          G0095390
ISN      193                     IF (PRODL.LE.ZERO) T3L=ZERO                                  G0095400
ISN      195                     PRODV=TWO*(GRADMV*GRADPV)                                    G0095410
ISN      196                     IF (PRODV.GT.ZERO) T3V=COEFF3*PRODV/(GRADMV+GRADPV)          G0095420
ISN      198                     IF (PRODV.LE.ZERO) T3V=ZERO                                  G0095430
ISN      200                   END IF                                                         G0095440
         C                                                                                    G0095450
ISN      201                  ACCUM(ICOMPL,JGRPJ)=TERM1L-T2L-T3L                              G0095460
ISN      202                  ACCUM(ICOMPV,JGRPJ)=TERM1V-T2V-T3V                              G0095470
ISN      203                END IF                                                            G0095480
         C                                                                                    G0095490
ISN      204              IF (EQCD.EQ.MATCHC.OR.EQCD.EQ.BOTH) THEN                          G0095500
         C                   USE THE MATCHING CONDITIONS, EQUATION (II.28).                   G0095510
ISN      205                MATCHL=(DT*VFDOTN(I))*                                          G0095520
         1                   (CONCL(ICOMPO,JGRPFM)-CONCL(ICOMPO,JGRPFP))                     G0095530
ISN      206                MATCHV=(DT*VFDOTN(I))*                                          G0095540
         1                   (CONCV(ICOMPO,JGRPFM)-CONCV(ICOMPO,JGRPFP))                     G0095550
ISN      207                IF (JTYFRN(JGRPJ).EQ.2) THEN                                    G0095560
ISN      208                   ACCUM(ICOMPL,JGRPJ)=ACCUM(ICOMPL,JGRPJ)+MATCHL               G0095570
ISN      209                   ACCUM(ICOMPV,JGRPJ)=ACCUM(ICOMPV,JGRPJ)+MATCHV               G0095580
ISN      210                END IF                                                          G0095590
ISN      211                IF (JTYFRN(JGRPJ).EQ.3) THEN                                    G0095600
ISN      212                   ACCUM(ICOMPL,JGRPJ)=ACCUM(ICOMPL,JGRPJ)-MATCHL               G0095610
ISN      213                   ACCUM(ICOMPV,JGRPJ)=ACCUM(ICOMPV,JGRPJ)-MATCHV               G0095620
ISN      214                END IF                                                          G0095630
ISN      215              END IF                                                            G0095640
         C                                                                                    G0095650
ISN      216   220       CONTINUE                                                          G0095660
ISN      217             END IF                                                            G0095670
ISN      218   300  CONTINUE                                                              G0095680
ISN      219           END IF                                                              G0095690
         C                                                                                    G0095700
         C                                                                                    G0095710
ISN      220       RETURN                                                                  G0095720
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                 *....*...1.........2.........3.........4.........5.........6.........7.*.......8
ISN      221         END                                                                     G0095730
*STATISTICS*   SOURCE STATEMENTS = 209, PROGRAM SIZE = 13380 BYTES, PROGRAM NAME = ACUMCL    PAGE:  192.
*STATISTICS*    NO DIAGNOSTICS GENERATED.
**ACUMCL** END OF COMPILATION 38 ******
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OPTIONS IN EFFECT: NOLIST NOMAP NOXREF NOGOSTMT NODECK SOURCE TERM NOOBJECT FIXED NOTEST TRMFLG SRCFLG
NOSYM NORENT SDUMP AUTODBL(NONE) NOSXM IL
OPT(0) LANGLVL(77) NOFIPS FLAG(I) NAME(MAIN) LINECOUNT(60) CHARLEN(500)

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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
                C.GVCFCL
                C
                C  SOO.  CALCULATE SOME COEFFICIENTS IN THE GOVERNING EQUATIONS.                    G0095740
                C                                                                                  G0095750
                C                                                                                  G0095760
ISN       1             SUBROUTINE GVCFCL(ALGRPS,NGRPMX,NCALCS,GRPLIS,                           G0095770
                     1                  GVCXH,GVCXV,GVCYH,GVCYV)                                 G0095780
ISN       2             IMPLICIT DOUBLE PRECISION (A-H,K,O-Z)                                    G0095790
                C                                                                                  G0095800
ISN       3             DOUBLE PRECISION GVCXH(NGRPMX),GVCXV(NGRPMX)                             G0095810
ISN       4             DOUBLE PRECISION GVCYH(NGRPMX),GVCYV(NGRPMX)                             G0095820
ISN       5             DOUBLE PRECISION JACOBN                                                  G0095830
ISN       6             INTEGER GRPLIS(NCALCS)                                                   G0095840
ISN       7             LOGICAL ALGRPS                                                           G0095850
                C                ALGRPS IS NOT REFERENCED IN THIS SUBROUTINE.  ITS MAIN PURPOSE  G0095860
                C                IS TO DRAW ATTENTION TO THE FACT THAT THIS SUBROUTINE           G0095870
                C                HAS TWO MODES IN WHICH IT CAN BE CALLED.                        G0095880
                C                                                                                  G0095890
ISN       8             CHARACTER*4 CYLN,SPHR,CSYSTM                                             G0095900
                C                                                                                  G0095910
ISN       9             COMMON/CORSYS/CYLN,SPHR,CSYSTM                                           G0095920
ISN      10             COMMON/IJTBIJ/IOFGRP(55),JOFGRP(55),JGRPIJ(36,24)                        G0095930
ISN      11             COMMON/GLINEC/GLINEO(36),GLINER(24)                                      G0095940
ISN      12             COMMON/TGRID /SINTHT(36),COSTHT(36),SINTHA(36),COSTHA(36),               G0095950
                     1                SINTMA(36),COSTMA(36),SINTPA(36),COSTPA(36),             G0095960
ISN      13             COMMON/DGRID /DTHTAM(36),DTHTAP(36),DOPHHH(36),DTHETA(36),             G0095970
                     1                DFOHTM(36),DFOHTP(36),                                   G0095980
                     2                DRPHHH(24),DRADM1(24),DRADP1(24)                         G0095990
ISN      14             COMMON/FRNTCF/DCENDS,CENDIS,FRNDIS(36),DFRDTH(36),FRFRTH(36),          G0096000
                     1                VFDOTH(36),XIRING(36),YIRING(36)                         G0096010
                C                                                                                  G0096020
                C  INPUT SCALARS: NCALCS,CSYSTM                                                    G0096030
                C  INPUT  ARRAYS: GRPLIS,IOFGRP,JOFGRP,GLINER,FRNDIS,DFRDTH,                       G0096040
                C                 COSTHT,SINTHT,DRPHHH,DOPHHH                                      G0096050
                C  OUTPUT  ARRAYS: GVCXH,GVCXV,GVCYH,GVCYV                                         G0096060
                C                                                                                  G0096070
ISN      15             DO 100 ICALC=1,NCALCS                                                    G0096080
ISN      16               JGRPJ=GRPLIS(ICALC)                                                    G0096090
ISN      17               IF (JGRPJ.GT.1) THEN                                                   G0096100
ISN      18                 I=IOFGRP(JGRPJ)                                                      G0096110
ISN      19                 J=JOFGRP(JGRPJ)                                                      G0096120
                C                                                                                  G0096130
ISN      20                 IF (CSYSTM.EQ.CYLN) THEN                                             G0096140
ISN      21                   JACOBN=GLINER(J)*FRNDIS(I)**2                                      G0096150
                C                    SINCE JGRPJ > 1, J CANNOT EQUAL 1.                            G0096160
                C                    AND JACOBN CANNOT EQUAL ZERO.                                 G0096170
ISN      22                   DXDO=GLINER(J)*(DFRDTH(I)*COSTHT(I)-FRNDIS(I)*SINTHT(I))           G0096180
ISN      23                   DYDO=GLINER(J)*(DFRDTH(I)*SINTHT(I)+FRNDIS(I)*COSTHT(I))           G0096190
ISN      24                   DXDR=FRNDIS(I)*COSTHT(I)                                           G0096200
ISN      25                   DYDR=FRNDIS(I)*SINTHT(I)                                           G0096210
ISN      26                   GVCXH(JGRPJ)= DXDR/(-JACOBN*DOPHHH(I))                             G0096220
ISN      27                   GVCYH(JGRPJ)=-DYDR/(-JACOBN*DOPHHH(I))                             G0096230
ISN      28                   GVCXV(JGRPJ)=-DXDO/(-JACOBN*DRPHHH(J))                             G0096240
                                                                                                   G0096250
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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
ISN      29                   GVCYV(JGRPJ)= DYDO/(-JACOBN*DRPHHH(J))
                C                    THESE SIGNS MUST BE CHECKED VERY CAREFULLY.                   G0096260
ISN      30                 END IF                                                               G0096270
                C                                                                                  G0096280
ISN      31               IF (CSYSTM.EQ.SPHR) THEN                                             G0096290
ISN      32                 JACOBN=GLINER(J)*FRNDIS(I)**2                                      G0096300
                C                    SINCE JGRPJ > 1, J CANNOT EQUAL 1.                            G0096310
                C                    AND JACOBN CANNOT EQUAL ZERO.                                 G0096320
ISN      33                   DXDO=GLINER(J)*(DFRDTH(I)*COSTHT(I)-FRNDIS(I)*SINTHT(I))           G0096330
ISN      34                   DYDO=GLINER(J)*(DFRDTH(I)*SINTHT(I)+FRNDIS(I)*COSTHT(I))           G0096340
ISN      35                   DXDR=FRNDIS(I)*COSTHT(I)                                           G0096350
ISN      36                   DYDR=FRNDIS(I)*SINTHT(I)                                           G0096360
ISN      37                   GVCXH(JGRPJ)= DXDR/(-JACOBN*DOPHHH(I))                             G0096370
ISN      38                   GVCYH(JGRPJ)=-DYDR/(-JACOBN*DOPHHH(I))                             G0096380
ISN      39                   GVCXV(JGRPJ)=-DXDO/(-JACOBN*DRPHHH(J))                             G0096390
ISN      40                   GVCYV(JGRPJ)= DYDO/(-JACOBN*DRPHHH(J))                             G0096400
                C                    THESE SIGNS MUST BE CHECKED VERY CAREFULLY.                   G0096410
ISN      41                 END IF                                                               G0096420
                C                                                                                  G0096430
ISN      42               END IF                                                                 G0096440
ISN      43   100 CONTINUE                                                                        G0096450
                C                                                                                  G0096460
ISN      44             RETURN                                                                   G0096470
ISN      45             END                                                                      G0096480
                                                                                                   G0096490
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STATISTICS SOURCE STATEMENTS = 45, PROGRAM SIZE = 3608 BYTES, PROGRAM NAME = GVCFCL PAGE: 199.

STATISTICS NO DIAGNOSTICS GENERATED.

GVCFCL END OF COMPILATION 39 ******

OPTIONS IN EFFECT: NOLIST NOMAP NOXREF NOGOSTMT NODECK SOURCE TERM NOOBJECT FIXED NOTEST TRMFLG SRCFLG
NOSYM NORENT SDUMP AUTODBL(NONE) NOSXM IL
OPT(0) LANGLVL(77) NOFIPS FLAG(I) NAME(MAIN) LINECOUNT(60) CHARLEN(500)

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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
                C FLTMCL                                                                          G0096500
                C                                                                                 G0096510
                C  SOO.  CALCULATE VARIOUS FLOW TERMS ACROSS EACH EDGE IN THE LIST.               G0096520
                C                                                                                 G0096530
ISN         1         SUBROUTINE FLTMCL(ALEDGS,TEST,NEDGMX,NOMAX,NCOMPS,NBALNS,                 G0096540
                1                   NCALCS,EDGLIS,                                            G0096550
                2                   FLTMXA,FLTMYA,FLTMTA)                                     G0096560
                C       THE PARAMETER ALEDGS IS RESERVED FOR POSSIBLE FUTURE USE.                 G0096570
ISN         2         IMPLICIT DOUBLE PRECISION (A-H,K,O-Z)                                     G0096580
                C                                                                                 G0096590
ISN         3         LOGICAL ALEDGS,TEST,LSPECL                                                G0096600
ISN         4         INTEGER EDGLIS(NEDGMX)                                                    G0096610
ISN         5         DOUBLE PRECISION FLTMXA(NBALNS,NEDGMX),FLTMYA(NBALNS,NEDGMX)              G0096620
ISN         6         DOUBLE PRECISION FLTMTA(NBALNS,NEDGMX)                                    G0096630
ISN         7         DOUBLE PRECISION JACOBN                                                   G0096640
ISN         8         DOUBLE PRECISION FLTMX(10),FLTMY(10),FLTMXY(10)                           G0096650
                C       DOUBLE PRECISION FLTFX(10),FLTFY(10),FLTFXY(10) WAS DELETED.          G0096660
ISN         9         DOUBLE PRECISION LPHIO,LPHIV,LDFSPO,LDFSPV,LTAUO,LTAUV,LTAUM              G0096670
ISN        10         INTEGER JUPP(10)                                                          G0096680
ISN        11         DOUBLE PRECISION LTAPMC(10),LDFSPC(10),LPHIP(6,10),LMC(6,10)              G0096690
                C                                                                                 G0096700
ISN        12         DOUBLE PRECISION LAMBDA                                                   G0096710
ISN        13         CHARACTER*4 HORZ,VERT                                                     G0096720
ISN        14         CHARACTER*4 JORIEN,EDGOR                                                  G0096730
ISN        15         CHARACTER*4 CYLN,SPHR,CSYSTM                                              G0096740
ISN        16         LOGICAL L2SYMM,LCIRCL                                                     G0096750
ISN        17         CHARACTER*4 CENT,FRNI,FRNO,BOUN,AXIS,INTR,EDTYPE                          G0096760
ISN        18         LOGICAL LROCK                                                             G0096770
                C                                                                                 G0096780
ISN        19         COMMON/PVAPOR/PHAT(55),POIL(55),PSOL(55),DPHAT(55),DPOIL(55),             G0096790
                1                   DPSOL(55),DPDT(55),YMOLE(4,55),YO(55),YV(55),YS(55)       G0096800
ISN        20         COMMON/STATEV/SMP(55),SGP(55),SOP(55),T(55),P(55),                        G0096810
                1                   XMOLE(3,55),XO(55),XSOL(55),XM(55)                        G0096820
ISN        21         COMMON/FLUPRO/DMP(55),DOP(55),DGP(55),UMP(55),UOP(55),UGP(55),            G0096830
                1                   CMP(55),COP(55),CGP(55),KO(55),KSOL(55),LAMBDA(55),       G0096840
                2                   DENSOL(55),DENSOM(55),DENSOS(55),                         G0096850
                3                   DFSPCM(55),DFSPCO(55),DFSPCV(55),GASCON                   G0096860
ISN        22         COMMON/RESPRO/KA,KC(55),PHI(55),DBCB(55),PCAPM(55),PCAPV(55)              G0096870
ISN        23         COMMON/PRM123/KRGP(55),KROP(55),KRMP(55),AKROG(55),AKROM(55)              G0096880
ISN        24         COMMON/ENHLPY/ENHLMA(55),ENHVMA(55),ENHLOS(55),ENHVOS(55),                G0096890
                1                   ENHLOL(55),ENHVOL(55),ENHLOM(55),                         G0096900
                2                   ENHMP(55) ,ENHOP(55) ,ENHVP(55) ,                         G0096910
                3                   ENHMMH,ENHMPH,ENHOMH,ENHOPH,ENHVMH,ENHVPH                 G0096920
ISN        25         COMMON/CTEMP1/NMCS                                                        G0096930
ISN        26         COMMON/BASICS/ZERO,HALF,ONE,TWO                                           G0096940
ISN        27         COMMON/IBASCS/NULL                                                        G0096950
ISN        28         COMMON/DIMENS/NDIMNS,NX,NY,NOS,NRS,NRFM,NRFP                              G0096960
ISN        29         COMMON/DIRXNC/HORZ,VERT                                                   G0096970
ISN        30         COMMON/GRAVTY/GX,GY,DENMSM(55),DENMSO(55),DENMSV(55),GRAVP(55)            G0096980
ISN        31         COMMON/EDCHAR/JORIEN(8),EDGOR(150)                                        G0096990
ISN        32         COMMON/EDTOE2/JGRPOE(6,150),JDIROE(2,150)                                 G0097000
ISN        33         COMMON/CORSYS/CYLN,SPHR,CSYSTM                                            G0097010
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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
ISN        34         COMMON/LOGSYM/L2SYMM,LCIRCL                                               G0097020
ISN        35         COMMON/EDGTYP/CENT,FRNI,FRNO,BOUN,AXIS,INTR,EDTYPE(150)                   G0097030
ISN        36         COMMON/IJTBIJ/IOFGRP(55),JOFGRP(55),JGRPIJ(36,24)                         G0097040
ISN        37         COMMON/LROCKC/LROCK(150)                                                  G0097050
ISN        38         COMMON/GLINEC/GLINEO(36),GLINER(24)                                       G0097060
ISN        39         COMMON/TGRID /SINTHT(36),COSTHT(36),SINTHA(36),COSTHA(36),                G0097070
                1                   SINIMA(36),COSIMA(36),SINIPA(36),COSIPA(36),              G0097080
ISN        40         COMMON/DGRID /DTHTAM(36),DTHTAP(36),DOPHMH(36),DTHETA(36),                G0097090
                1                   DFOMTM(36),DFOMTP(36),                                    G0097100
                2                   DRPHMH(24),DRADM1(24),DRADP1(24)                          G0097110
ISN        41         COMMON/FRMTCF/DCENDS,CENDIS,FRNDIS(36),DFRDTH(36),FRFRTH(36),             G0097120
                1                   VFDOTM(36),XIRING(36),YIRING(36)                          G0097130
                C                                                                             G0097140
                C  PAGE 1A                                                                    G0097150
                C   INPUT SCALARS: HALF,ONE,KA,NMCS                                          G0097160
                C   INPUT  ARRAYS: DMP,P,PCAPM,GRAVP,DFSPCM,KRMP,UMP,DOP,XMOLE               G0097170
                C   LOCAL  ARRAYS: LPHIP,LMC,LDFSPC,JUPP,LTAPMC                              G0097180
                C                                                                             G0097190
                C  PAGE 1B                                                                    G0097200
                C   INPUT  ARRAY : LROCK                                                      G0097210
                C                                                                             G0097220
                C  PAGE 2A                                                                    G0097230
                C   INPUT  SCALAR: ZERO                                                       G0097240
                C   INPUT  ARRAYS: DFSPCO,KROP,UOP,DGP,PCAPV,YMOLE,DFSPCV,KRGP,UGP          G0097250
                C                                                                             G0097260
                C  PAGE 2B                                                                    G0097270
                C   INPUT  ARRAYS: T,KC                                                       G0097280
                C                                                                             G0097290
                C  PAGE 3A                                                                    G0097300
                C   INPUT  SCALAR: NBALNS                                                     G0097310
                C                                                                             G0097320
                C  PAGE 3B                                                                    G0097330
                C   INPUT SCALARS: CENT,FRNI,FRNO,BOUN,AXIS,INTR                              G0097340
                C   INPUT  ARRAYS: EDTYPE,GLINER                                             G0097350
                C                                                                             G0097360
                C  PAGE 4A                                                                    G0097370
                C   INPUT  ARRAYS: COSTHT,SINTHT                                             G0097380
                C   LOCAL  ARRAYS: FLTMXY,FLTMX,FLTMY                                        G0097390
                C                                                                             G0097400
                C  PAGE 4B                                                                    G0097410
                C   INPUT  SCALAR: CSYSTM,CYLN,SPHR,NRFM                                     G0097420
                C   INPUT  ARRAYS: DFRDTH,FRNDIS,FRFRTH,DTHETA                               G0097430
                C                                                                             G0097440
                C  PAGE 5A                                                                    G0097450
                C   INPUT SCALAR : NRFP                                                       G0097460
                C                                                                             G0097470
                C  PAGE 5B                                                                    G0097480
                C   INPUT SCALAR : TWO                                                        G0097490
                C                                                                             G0097500
                C  PAGE 6A                                                                    G0097510
                C   NOTHING NEW                                                             G0097520
                C                                                                             G0097530
                C  PAGE 6B                                                                    G0097540
                C   INPUT  ARRAY : DTHTAP                                                    G0097550
                C                                                                             G0097560
                C  PAGE 7A                                                                    G0097570
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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
                C
                C   INPUT  ARRAYS: COSTHA,SINTHA                                                  G0097580
                C                                                                                  G0097590
                C  PAGE 78                                                                         G0097600
                C    INPUT  ARRAYS: ENHLNA,ENHLOL,ENHLOS,ENHLOH,ENHVNA,ENHVOL,ENHVOS               G0097610
                C  OUTPUT  ARRAYS: FLTMXA,FLTMYA,FLTMTA                                            G0097620
                C                                                                                  G0097630
 ISN      42            DO 900 ICALC=1,NCALCS                                                      G0097640
 ISN      43               JEDGEJ=EDGLIS(ICALC)                                                    G0097650
 ISN      44               JGRPH=JGRPOE(2,JEDGEJ)                                                  G0097660
 ISN      45               JGRPP=JGRPOE(5,JEDGEJ)                                                  G0097670
 ISN      46               IF (JGRPH.LE.NULL) JGRPH=JGRPP                                          G0097680
 ISN      48               IF (JGRPP.LE.NULL) JGRPP=JGRPH                                          G0097690
                C              IF BOTH ARE NULL, THAT MEANS TROUBLE.                               G0097700
 ISN      50               IH=IOFGRP(JGRPH)                                                        G0097710
 ISN      51               IP=IOFGRP(JGRPP)                                                        G0097720
 ISN      52               JH=JOFGRP(JGRPH)                                                        G0097730
 ISN      53               JP=JOFGRP(JGRPP)                                                        G0097740
 ISN      54               IF (EDGOR(JEDGEJ).EQ.VERT) I=IP                                         G0097750
 ISN      56               IF (EDGOR(JEDGEJ).EQ.HORZ) J=JP                                         G0097760
 ISN      58               IF (TEST) THEN                                                          G0097770
 ISN      59                  IF (EDGOR(JEDGEJ).EQ.VERT.AND.IH.NE.IP.AND.JH.GT.1)                  G0097780
                     !            WRITE(6,21)JEDGEJ,IH,IP                                        G0097790
 ISN      61          21           FORMAT(' ***<--- IN FLTMCL, AT A VERTICAL EDGE, ',I4,          G0097800
                     1                 '   IH=',I3,' AND IP=',I3,' ARE NOT EQUAL(')               G0097810
 ISN      62                  IF (EDGOR(JEDGEJ).EQ.HORZ.AND.JH.NE.JP)                             G0097820
                     !            WRITE(6,22)JEDGEJ,JH,JP                                        G0097830
 ISN      64          22           FORMAT(' ***<--- IN FLTMCL, AT A HORIZONTAL EDGE ',I4,         G0097840
                     1                 '   JH=',I3,' AND JP=',I3,' ARE NOT EQUAL(')               G0097850
 ISN      65                  END IF                                                              G0097860
                C                                                                                  G0097870
 ISN      66               LSPECL = ( LROCK(JEDGEJ).OR.(EDTYPE(JEDGEJ).EQ.BOUN)                  G0097880
                     1                          .OR.(EDTYPE(JEDGEJ).EQ.AXIS) )                  G0097890
 ISN      67               IF (.NOT.LSPECL) THEN                                                  G0097900
                C                                                                                  G0097910
                C                 THE LIQUID-WATER PHASE.                                          G0097920
                C                                                                                  G0097930
 ISN      68                  DENSAV=HALF*(DENWSN(JGRPH)+DENWSN(JGRPP))                          G0097940
 ISN      69                  DO 40 ILOC=1,6                                                     G0097950
 ISN      70                     JGRPJ=JGRPOE(ILOC,JEDGEJ)                                       G0097960
 ISN      71                     LPHIP(ILOC,1)=P(JGRPJ)+PCAPH(JGRPJ)+DENSAV*GRAVP(JGRPJ)         G0097970
 ISN      72                     LMC(ILOC,1)=ONE                                                 G0097980
 ISN      73          40      CONTINUE                                                           G0097990
 ISN      74                  LDFSPC(1)=HALF*(DFSPCW(JGRPH)+DFSPCW(JGRPP))                       G0098000
 ISN      75                  PHIJH=LPHIP(2,1)                                                   G0098010
 ISN      76                  PHIJP=LPHIP(5,1)                                                   G0098020
 ISN      77                  IF (PHIJH.GE.PHIJP) JGRPWT=JGRPH                                   G0098030
 ISN      79                  IF (PHIJP.GT.PHIJH) JGRPWT=JGRPP                                   G0098040
 ISN      81                  IF (EDTYPE(JEDGEJ).EQ.FRNI) JGRPWT=JGRPP                           G0098050
 ISN      83                  IF (EDTYPE(JEDGEJ).EQ.FRNO) JGRPWT=JGRPH                           G0098060
                C                THESE FOUR STATEMENTS DEFINING JGRPWT                             G0098070
                C                MAY NOT BE CONSOLIDATED.  OTHERWISE,                              G0098080
                C                WHAT IS NOW THE SECOND STATEMENT WOULD OVERRIDE                   G0098090
                C                WHAT IS NOW THE THIRD STATEMENT.                                  G0098100
 ISN      85                  JUPP(1)=JGRPWT                                                     G0098110
 ISN      86                  LTAPWC(1)=KA*KRWP(JGRPWT)*DWP(JGRPWT)/UWP(JGRPWT)                  G0098120
                C                                                                                  G0098130
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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
                C                 THE LIQUD-HYDROCARBON PHASE.                                     G0098140
                C                                                                                  G0098150
 ISN      87                  DENSAV=HALF*(DENWSO(JGRPH)+DENWSO(JGRPP))                          G0098160
 ISN      88                  DO 56 ILOC=1,6                                                     G0098170
 ISN      89                     JGRPJ=JGRPOE(ILOC,JEDGEJ)                                       G0098180
 ISN      90                     LPHIO=P(JGRPJ)+DENSAV*GRAVP(JGRPJ)                              G0098190
 ISN      91                     DO 54 IC=1,NHCS                                                 G0098200
 ISN      92                        LPHIP(ILOC,IC+1)=LPHIO                                       G0098210
 ISN      93                        LMC(ILOC,IC+1)=XMOLE(IC,JGRPJ)                               G0098220
 ISN      94          54         CONTINUE                                                        G0098230
 ISN      95          56      CONTINUE                                                           G0098240
 ISN      96                  LDFSPO=HALF*(DFSPCO(JGRPH)+DFSPCO(JGRPP))                          G0098250
 ISN      97                  PHIJH=LPHIP(2,2)                                                   G0098260
 ISN      98                  PHIJP=LPHIP(5,2)                                                   G0098270
 ISN      99                  IF (PHIJH.GE.PHIJP) JGRPWT=JGRPH                                   G0098280
 ISN     101                  IF (PHIJP.GT.PHIJH) JGRPWT=JGRPP                                   G0098290
 ISN     103                  IF (EDTYPE(JEDGEJ).EQ.FRNI) JGRPWT=JGRPP                           G0098300
 ISN     105                  IF (EDTYPE(JEDGEJ).EQ.FRNO) JGRPWT=JGRPH                           G0098310
                C                THESE FOUR STATEMENTS DEFINING JGRPWT                             G0098320
                C                MAY NOT BE CONSOLIDATED.  OTHERWISE,                              G0098330
                C                WHAT IS NOW THE SECOND STATEMENT WOULD OVERRIDE                   G0098340
                C                WHAT IS NOW THE THIRD STATEMENT.                                  G0098350
 ISN     107                  LTAUO=KA*KROP(JGRPWT)*DOP(JGRPWT)/UOP(JGRPWT)                      G0098360
 ISN     108                  DO 58 IC=1,NHCS                                                    G0098370
 ISN     109                     LDFSPC(IC+1)=LDFSPO                                             G0098380
 ISN     110                     JUPP(IC+1)=JGRPWT                                               G0098390
 ISN     111                     LTAPWC(IC+1)=LTAUO*XMOLE(IC,JGRPWT)                             G0098400
 ISN     112          58      CONTINUE                                                           G0098410
                C                                                                                  G0098420
                C                 THE VAPOUR PHASE.                                                G0098430
                C                                                                                  G0098440
 ISN     113                  DENSAV=HALF*(DENWSV(JGRPH)+DENWSV(JGRPP))                          G0098450
 ISN     114                  IHL    =NHCS+2                                                     G0098460
 ISN     115                  NCOMPV=NHCS+1                                                      G0098470
 ISN     116                  DO 66 ILOC=1,6                                                     G0098480
 ISN     117                     JGRPJ=JGRPOE(ILOC,JEDGEJ)                                       G0098490
 ISN     118                     LPHIV=P(JGRPJ)+PCAPV(JGRPJ)+DENSAV*GRAVP(JGRPJ)                 G0098500
 ISN     119                     DO 64 IC=1,NCOMPV                                               G0098510
 ISN     120                        LPHIP(ILOC,IHL+IC)=LPHIV                                     G0098520
 ISN     121          64         CONTINUE                                                        G0098530
 ISN     122                     LMC(ILOC,IHL+1)=YMOLE(4,JGRPJ)                                  G0098540
 ISN     123                     LMC(ILOC,IHL+2)=YMOLE(1,JGRPJ)                                  G0098550
 ISN     124                     LMC(ILOC,IHL+3)=YMOLE(2,JGRPJ)                                  G0098560
 ISN     125                     LMC(ILOC,IHL+4)=ZERO                                            G0098570
 ISN     126          66      CONTINUE                                                           G0098580
 ISN     127                  LDFSPV=HALF*(DFSPCV(JGRPH)+DFSPCV(JGRPP))                          G0098590
 ISN     128                  PHIJH=LPHIP(2,6)                                                   G0098600
 ISN     129                  PHIJP=LPHIP(5,6)                                                   G0098610
 ISN     130                  IF (PHIJH.GE.PHIJP) JGRPWT=JGRPH                                   G0098620
 ISN     132                  IF (PHIJP.GT.PHIJH) JGRPWT=JGRPP                                   G0098630
 ISN     134                  IF (EDTYPE(JEDGEJ).EQ.FRNI) JGRPWT=JGRPP                           G0098640
 ISN     136                  IF (EDTYPE(JEDGEJ).EQ.FRNO) JGRPWT=JGRPH                           G0098650
                C                THESE FOUR STATEMENTS DEFINING JGRPWT                             G0098660
                C                MAY NOT BE CONSOLIDATED.  OTHERWISE,                              G0098670
                C                WHAT IS NOW THE SECOND STATEMENT WOULD OVERRIDE                   G0098680
                C                WHAT IS NOW THE THIRD STATEMENT.                                  G0098690
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                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
ISN      138                LTAUV=KA*KRGP(JGRPWT)*DGP(JGRPWT)/UGP(JGRPWT)                    G0098700
ISN      139                DO 68 IC=1,NCOMPV                                                G0098710
ISN      140                   LDFSPC(IHL+IC)=LDFSPV                                         G0098720
ISN      141                   JUPP(IHL+IC)=JGRPWT                                           G0098730
ISN      142             68 CONTINUE                                                         G0098740
ISN      143                LTAPMC(IHL+1)=LTAUV*YMOLE(4,JGRPWT)                              G0098750
ISN      144                LTAPMC(IHL+2)=LTAUV*YMOLE(1,JGRPWT)                              G0098760
ISN      145                LTAPMC(IHL+3)=LTAUV*YMOLE(2,JGRPWT)                              G0098770
ISN      146                LTAPMC(IHL+4)=ZERO                                               G0098780
                C                                                                           G0098790
                C                  HEAT FLOW.                                               G0098800
                C                                                                           G0098810
ISN      147                IHV=IHL+IHL                                                      G0098820
                C                  HISTORICALLY, IHL HAS EQUALLED  5,                       G0098830
                C                                AND IHV HAS EQUALLED 10.                   G0098840
ISN      148                DO 76 ILOC=1,6                                                   G0098850
ISN      149                   JGRPJ=JGRPOE(ILOC,JEDGEJ)                                     G0098860
ISN      150                   LPHIP(ILOC,IHL)=LPHIP(ILOC,IHL-1)                             G0098870
ISN      151                   LPHIP(ILOC,IHV)=LPHIP(ILOC,IHL+1)                             G0098880
                C                     IN ORDER TO TREAT THERMAL CONDUCTION THE SAME AS      G0098890
                C                     MOLAR FLUX BY DISPERSION:                             G0098900
ISN      152                   LMC(ILOC,IHL)=T(JGRPJ)                                        G0098910
ISN      153                   LMC(ILOC,IHV)=ZERO                                            G0098920
ISN      154             76 CONTINUE                                                         G0098930
                C                  IN ORDER TO TREAT THERMAL CONDUCTION THE SAME AS         G0098940
                C                  MOLAR FLUX BY DISPERSION:                                G0098950
ISN      155                LDFSPC(IHL)=HALF*(KC(JGRPW)+KC(JGRPP))                          G0098960
ISN      156                LDFSPC(IHV)=ZERO                                                 G0098970
ISN      157                JUPP(IHL)=JUPP(IHL-1)                                            G0098980
ISN      158                JUPP(IHV)=JUPP(IHL+1)                                            G0098990
ISN      159                LTAPMC(IHL)=ZERO                                                 G0099000
ISN      160                LTAPMC(IHV)=ZERO                                                 G0099010
                C                                                                           G0099020
                C                  AUXILIARY BALANCES, JUST IN CASE.                        G0099030
                C                                                                           G0099040
ISN      161                IHVP1=IHV+1                                                      G0099050
ISN      162                IF (NBALNS.GE.IHVP1) THEN                                        G0099060
ISN      163                   DO 86 IBAL=IHVP1,NBALNS                                       G0099070
ISN      164                      DO 84 ILOC=1,6                                             G0099080
ISN      165                         LPHIP(ILOC,IBAL)=ZERO                                   G0099090
ISN      166                         LMC(ILOC,IBAL)=ZERO                                     G0099100
ISN      167             84          CONTINUE                                               G0099110
ISN      168                      LDFSPC(IBAL)=ZERO                                         G0099120
ISN      169                      JUPP(IBAL)=JGRPW                                          G0099130
ISN      170                      LTAPMC(IBAL)=ZERO                                         G0099140
ISN      171             86       CONTINUE                                                  G0099150
ISN      172                   END IF                                                       G0099160
ISN      173                END IF                                                          G0099170
                C                                                                           G0099180
ISN      174             IF (LSPECL) THEN                                                   G0099190
ISN      175                DO 94 IBALN=1,NBALNS                                            G0099200
ISN      176                   DO 92 ILOC=1,6                                               G0099210
ISN      177                      LPHIP(ILOC,IBALN)=ZERO                                    G0099220
ISN      178                      LMC(ILOC,IBALN)=ZERO                                      G0099230
ISN      179             92       CONTINUE                                                  G0099240
ISN      180                   JUPP(IBALN)=JGRPW                                            G0099250
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                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
ISN      181                   LTAPMC(IBALN)=ZERO                                           G0099260
ISN      182                   LDFSPC(IBALN)=ZERO                                           G0099270
ISN      183             94 CONTINUE                                                        G0099280
ISN      184                IHL=NHCS+2                                                      G0099290
ISN      185                LDFSPC(IHL)=HALF*(KC(JGRPW)+KC(JGRPP))                          G0099300
ISN      186                LMC(2,IHL)=T(JGRPW)                                             G0099310
ISN      187                LMC(5,IHL)=T(JGRPP)                                             G0099320
                C                  THIS MUST BE MODIFIED IF HIGHER-ORDER FORMULAE ARE USED. G0099330
ISN      188             END IF                                                             G0099340
                C                                                                          G0099350
                C                                                                          G0099360
                C                  BRANCH BY EDGE TYPE:                                    G0099370
                C                                                                          G0099380
                C                  THERE ARE 6 CASES:                                      G0099390
                C        CENT   CASE 1: THE EDGE IS AN EDGE OF THE CENTRAL GRID BLOCK.     G0099400
                C        FRNI   CASE 2: THE EDGE IS AN INNER FRONT EDGE.                   G0099410
                C        FRNO   CASE 3: THE EDGE IS AN OUTER FRONT EDGE.                   G0099420
                C        BOUN   CASE 4: THE EDGE IS A  BOUNDARY EDGE.                      G0099430
                C        AXIS   CASE 5: THE EDGE IS A  SYMMETRY AXIS EDGE.                 G0099440
                C        INTR   CASE 6: THE EDGE IS AN ORDINARY INTERIOR EDGE.             G0099450
                C               HERE, THE (RESTRAINED) USE OF THE GO-TO STATEMENT          G0099460
                C               MAKES THE PROGRAM MORE READABLE.                           G0099470
                C               BUT ... IF AN EDGE IS IN CASE 2 OR CASE 3,                 G0099480
                C               THE CASE 6 CALCULATIONS ARE ALSO DONE.                     G0099490
                C                                                                          G0099500
ISN      189             IF (EDTYPE(JEDGEJ).EQ.CENT) GO TO 100                          G0099510
ISN      190             IF (EDTYPE(JEDGEJ).EQ.FRNI) GO TO 200                          G0099520
ISN      191             IF (EDTYPE(JEDGEJ).EQ.FRNO) GO TO 300                          G0099530
ISN      192             IF (EDTYPE(JEDGEJ).EQ.BOUN) GO TO 400                          G0099540
ISN      193             IF (EDTYPE(JEDGEJ).EQ.AXIS) GO TO 500                          G0099550
ISN      194             IF (EDTYPE(JEDGEJ).EQ.INTR) GO TO 600                          G0099560
                C               OTHERWISE                                                  G0099570
ISN      195             WRITE(6,95)JEDGEJ                                              G0099580
ISN      196          95 FORMAT(' ***+++ IN FLTMCL, EDGE #',I3,' IS NOT ONE',           G0099590
                     1      ' OF THE FIVE TYPES.')                                      G0099600
ISN      197             RETURN                                                         G0099610
                C                                                                          G0099620
ISN      198         100 CONTINUE                                                       G0099630
                C                  CASE 1: THE EDGE IS AN EDGE OF THE CENTRAL GRID BLOCK.  G0099640
                C                                                                          G0099650
ISN      199                CALL FLSCCL(L2SYMM,NBALNS,NOMAX,NOS,I,CENDIS,              G0099660
                     1                     XIRING,YIRING,LTAPMC,LPHIP,LDFSPC,LMC,      G0099670
                     2                     FLTMX,FLTMY)                                G0099680
                C                  I.E. CALL FLSCCL(L2SYMM,NBALNS,NOMAX,NOS,JO,CENDIS,     G0099690
                C                                   XIRING,YIRING,LTAPMC,LPHIP,LDFSPC,LMC, G0099700
                C                                   FLTMX,FLTMY)                           G0099710
                C                                                                          G0099720
ISN      200                CFACTR=COSTHT(IP)                                           G0099730
ISN      201                SFACTR=SINTHT(IP)                                           G0099740
ISN      202                DO 120 IBALN=1,NBALNS                                       G0099750
ISN      203                   FLTMXY(IBALN)=CFACTR*FLTMX(IBALN)+SFACTR*FLTMY(IBALN)    G0099760
ISN      204         120    CONTINUE                                                    G0099770
                C                  THE CONVECTIVE ENTHALPY TERMS ARE ADDED BELOW.          G0099780
ISN      205                GO TO 700                                                   G0099790
                C                                                                          G0099800
ISN      206         200 CONTINUE                                                       G0099810
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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
                C
                C              CASE 2: THE EDGE IS AN INNER FRONT EDGE.                                  G0099820
ISN      207          IF (CSYSTM.EQ.CYLN) THEN                                                          G0099830
                C              EQUATIONS (II.31) AND (II.32)
ISN      208              COEF1=(ONE+(DFRDTH(I)/FRNDIS(I))**2)/FRFRTH(I)                                G0099840
ISN      209              COEF2=(DFRDTH(I)/FRNDIS(I))/FRFRTH(I)                                         G0099850
ISN      210            END IF                                                                          G0099860
ISN      211          IF (CSYSTM.EQ.SPHR) THEN                                                          G0099870
                C              EQUATIONS (II.31) AND (II.32)                                           G0099880
ISN      212              COEF1=(ONE+(DFRDTH(I)/FRNDIS(I))**2)/FRFRTH(I)                                G0099890
ISN      213              COEF2=(DFRDTH(I)/FRNDIS(I))/FRFRTH(I)                                         G0099900
ISN      214            END IF                                                                          G0099910
ISN      215          DR=GLINER(NRFH)-GLINER(NRFH-1)                                                    G0099920
ISN      216          DO 220 IBALN=1,NBALNS                                                             G0099930
                C              EQUATION (II.31)                                                        G0099940
ISN      217            DPHDR = (LPHIP(5,IBALN)-LPHIP(2,IBALN))/DR                                      G0099950
ISN      218            DPHDTH=((LPHIP(6,IBALN)-LPHIP(3,IBALN))*DFDNTP(I)                               G0099960
                1                    +(LPHIP(5,IBALN)-LPHIP(4,IBALN))*DFDNTH(I) )                      G0099970
ISN      219            DPHDN =COEF1*DPHDR-COEF2*DPHDTH                                                 G0099980
                C              EQUATION (II.32)                                                        G0099990
ISN      220            DMCDR = (LMC(5,IBALN)-LMC(2,IBALN))/DR                                          G0000000
ISN      221            DMCDTH=((LMC(6,IBALN)-LMC(3,IBALN))*DFDNTP(I)                                   G0000010
                1                    +(LMC(5,IBALN)-LMC(4,IBALN))*DFDNTH(I) )                          G0000020
ISN      222            DMCDN =COEF1*DMCDR-COEF2*DMCDTH                                                 G0000030
                C              EQUATION (II.28)                                                        G0000040
ISN      223            FLTMXY(IBALN) = -                                                               G0000050
                1              LTAPHC(IBALN)*DPHDN + LDFSPC(IBALN)*DMCDN )                             G0000060
ISN      224            FLTMX(IBALN)=FLTMXY(IBALN)*COSTHT(I)                                            G0000070
ISN      225            FLTMY(IBALN)=FLTMXY(IBALN)*SINTHT(I)                                            G0000080
ISN      226      220   CONTINUE                                                                        G0000090
ISN      227          CFACTR=COSTHT(I)                                                                  G0000100
ISN      228          SFACTR=SINTHT(I)                                                                  G0000110
                C              THE CONVECTIVE ENTHALPY TERMS ARE ADDED BELOW.                          G0000120
ISN      229          GO TO 700                                                                         G0000130
                C                                                                                      G0000140
ISN      230      300 CONTINUE                                                                          G0000150
                C              CASE 3: THE EDGE IS AN OUTER FRONT EDGE.                                G0000160
ISN      231          IF (CSYSTM.EQ.CYLN) THEN                                                          G0000170
ISN      232            COEF1=(ONE+(DFRDTH(I)/FRNDIS(I))**2)/FRFRTH(I)                                  G0000180
ISN      233            COEF2=(DFRDTH(I)/FRNDIS(I))/FRFRTH(I)                                           G0000190
ISN      234          END IF                                                                            G0000200
ISN      235          IF (CSYSTM.EQ.SPHR) THEN                                                          G0000210
ISN      236            COEF1=(ONE+(DFRDTH(I)/FRNDIS(I))**2)/FRFRTH(I)                                  G0000220
ISN      237            COEF2=(DFRDTH(I)/FRNDIS(I))/FRFRTH(I)                                           G0000230
ISN      238          END IF                                                                            G0000240
ISN      239          DR=GLINER(NRFP+1)-GLINER(NRFP)                                                    G0000250
ISN      240          DO 320 IBALN=1,NBALNS                                                             G0000260
                C              EQUATION (II.31)                                                        G0000270
ISN      241            DPHDR = (LPHIP(5,IBALN)-LPHIP(2,IBALN))/DR                                      G0000280
ISN      242            DPHDTH=((LPHIP(3,IBALN)-LPHIP(2,IBALN))*DFDNTP(I)                               G0000290
                1                    +(LPHIP(2,IBALN)-LPHIP(1,IBALN))*DFDNTH(I) )                      G0000300
ISN      243            DPHDN =COEF1*DPHDR-COEF2*DPHDTH                                                 G0000310
                C              EQUATION (II.32)                                                        G0000320
ISN      244            DMCDR = (LMC(5,IBALN)-LMC(2,IBALN))/DR                                          G0000330
ISN      245            DMCDTH=((LMC(3,IBALN)-LMC(2,IBALN))*DFDNTP(I)                                   G0000340
                1                    +(LMC(2,IBALN)-LMC(1,IBALN))*DFDNTH(I) )                          G0000350
ISN      246            DMCDN =COEF1*DMCDR-COEF2*DMCDTH                                                 G0000360
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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
                C              EQUATION (II.28)                                                        G0000380
ISN      247            FLTMXY(IBALN) = -                                                               G0000390
                1              LTAPHC(IBALN)*DPHDN + LDFSPC(IBALN)*DMCDN )                             G0000400
ISN      248            FLTMX(IBALN)=FLTMXY(IBALN)*COSTHT(I)                                            G0000410
ISN      249            FLTMY(IBALN)=FLTMXY(IBALN)*SINTHT(I)                                            G0000420
ISN      250      320   CONTINUE                                                                        G0000430
ISN      251          CFACTR=COSTHT(I)                                                                  G0000440
ISN      252          SFACTR=SINTHT(I)                                                                  G0000450
                C              THE CONVECTIVE ENTHALPY TERMS ARE ADDED BELOW.                          G0000460
ISN      253          GO TO 700                                                                         G0000470
                C                                                                                      G0000480
ISN      254      400 CONTINUE                                                                          G0000490
                C              CASE 4: THE EDGE IS A  BOUNDARY EDGE.                                   G0000500
                C              ASSUME NO FLOW AT THE BOUNDARIES.                                       G0000510
                C              ACUMCL TAKES CARE OF THE MOVING BOUNDARY TERMS.                         G0000520
ISN      255          DO 420 IBALN=1,NBALNS                                                             G0000530
ISN      256            FLTMXY(IBALN)=ZERO                                                              G0000540
ISN      257            FLTMX( IBALN)=ZERO                                                              G0000550
ISN      258            FLTMY( IBALN)=ZERO                                                              G0000560
ISN      259      420   CONTINUE                                                                        G0000570
ISN      260          CFACTR=ONE                                                                        G0000580
ISN      261          SFACTR=ZERO                                                                       G0000590
ISN      262          GO TO 700                                                                         G0000600
                C                                                                                      G0000610
ISN      263      500 CONTINUE                                                                          G0000620
                C              CASE 5: THE EDGE IS A  SYMMETRY AXIS EDGE.                              G0000630
                C              THERE IS NO FLOW ACROSS THE AXIS OF SYMMETRY                            G0000640
                C              (ASSUMING THAT THERE IS  AN AXIS OF SYMMETRY).                          G0000650
ISN      264          DO 520 IBALN=1,NBALNS                                                             G0000660
ISN      265            FLTMXY(IBALN)=ZERO                                                              G0000670
ISN      266            FLTMX( IBALN)=ZERO                                                              G0000680
ISN      267            FLTMY( IBALN)=ZERO                                                              G0000690
ISN      268      520   CONTINUE                                                                        G0000700
ISN      269          CFACTR=ONE                                                                        G0000710
ISN      270          SFACTR=ZERO                                                                       G0000720
ISN      271          GO TO 700                                                                         G0000730
                C                                                                                      G0000740
ISN      272      600 CONTINUE                                                                          G0000750
                C              CASE 6: THE EDGE IS AN ORDINARY INTERIOR EDGE.                          G0000760
ISN      273          IF (EDGOR(JEDGE).EQ.VERT) THEN                                                    G0000770
                C                CASE 6V: THE INTERIOR EDGE IS VERTICAL.                               G0000780
ISN      274            RAVG=HALF*(GLINER(JP)+GLINER(JM))                                               G0000790
ISN      275            DR=GLINER(JP)-GLINER(JM)                                                        G0000800
ISN      276            IF (CSYSTM.EQ.CYLN) THEN                                                        G0000810
                C                EQUATIONS (I.9) AND (I.10) AT I,J+1/2.                                G0000820
ISN      277              DXDO = ( RAVG                                                                 G0000830
                1                    *(DFRDTH(I)*COSTHT(I)-FRNDIS(I)*SINTHT(I)) )                      G0000840
ISN      278              DYDO = ( RAVG                                                                 G0000850
                1                    *(DFRDTH(I)*SINTHT(I)+FRNDIS(I)*COSTHT(I)) )                      G0000860
ISN      279              DXDR = FRNDIS(I)*COSTHT(I)                                                    G0000870
ISN      280              DYDR = FRNDIS(I)*SINTHT(I)                                                    G0000880
                C                EQUATION (I.3) AT I,J+1/2.                                            G0000890
ISN      281              JACOBN=RAVG*(FRNDIS(I)**2)                                                    G0000900
ISN      282            END IF                                                                          G0000910
ISN      283          IF (CSYSTM.EQ.SPHR) THEN                                                          G0000920
                C                EQUATIONS (I.9) AND (I.10) AT I,J+1/2.                                G0000930
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                    *....*...1.........2.........3.........4.........5.........6.........7.*.......8

                    C                 DXDO = ( RAVG                                                  G0000940
ISN      284                                *(DFRDTH(I)*COSTHT(I)-FRNDIS(I)*SINTHT(I)) )            G0000950
                                      DYDO = ( RAVG                                                  G0000960
                                           *(DFRDTH(I)*SINTHT(I)+FRNDIS(I)*COSTHT(I)) )            G0000970
ISN      286                          DXDR = FRNDIS(I)*COSTHT(I)                                     G0000980
ISN      287                          DYDR = FRNDIS(I)*SINTHT(I)                                     G0000990
                    C                   EQUATION (I.3) AT I,J+1/2.                                  G0001000
ISN      288                          JACOBN=RAVG*(FRNDIS(I)**2)                                     G0001010
ISN      289                        END IF                                                           G0001020
ISN      290                      IF (TEST) THEN                                                     G0001030
ISN      291                        SJACBN=DXDR*DYDO-DYDR*DXDO                                       G0001040
                    C                                                                               G0001050
ISN      292                        CALL COMPAR(701,0,JACOBN,SJACBN,1.0D-4)                          G0001060
                    C                 I.E. CALL COMPAR(ICHECK,JFP,X,Y,ATOL)                         G0001070
ISN      293                        END IF                                                           G0001080
                    C                                                                               G0001090
ISN      294                      DO 620 IBALN=1,NBALNS                                              G0001100
                                      EQUATIONS (I.16B)                                             G0001110
                                                                                                    G0001120
                                    3. | .6                                                         G0001130
                                                                                                    G0001140
                                    2. | .5                                                         G0001150
                                                                                                    G0001160
                                    1. | .4                                                         G0001170
                                                                                                    G0001180
ISN      295                          DPHDTH = HALF*(                                                G0001190
                                            ((LPHIP(6,IBALN)+LPHIP(3,IBALN))                        G0001200
                                           -(LPHIP(5,IBALN)+LPHIP(2,IBALN)))*DFOMTP(I)              G0001210
                                          +((LPHIP(5,IBALN)+LPHIP(2,IBALN))                         G0001220
                                           -(LPHIP(4,IBALN)+LPHIP(1,IBALN)))*DFOMTM(I) )            G0001230
ISN      296                          DPHDR  = (LPHIP(5,IBALN)-LPHIP(2,IBALN) )/DR                   G0001240
ISN      297                          DMCDTH = HALF*(                                                G0001250
                                            ((LMC(6,IBALN)+LMC(3,IBALN))                            G0001260
                                           -(LMC(5,IBALN)+LMC(2,IBALN)))*DFOMTP(I)                  G0001270
                                          +((LMC(5,IBALN)+LMC(2,IBALN))                             G0001280
                                           -(LMC(4,IBALN)+LMC(1,IBALN)))*DFOMTM(I) )                G0001290
ISN      298                          DMCDR  = (LMC(5,IBALN)-LMC(2,IBALN) )/DR                       G0001300
                    C                   EQUATIONS (I.16B) AND (I.8).                                G0001310
ISN      299                          DXPH=-DXDO*DPHDR+DXDR*DPHDTH                                   G0001320
ISN      300                          DYPH= DYDO*DPHDR-DYDR*DPHDTH                                   G0001330
ISN      301                          DXMC=-DXDO*DMCDR+DXDR*DMCDTH                                   G0001340
ISN      302                          DYMC= DYDO*DMCDR-DYDR*DMCDTH                                   G0001350
                    C                   EQUATION (I.15)                                             G0001360
ISN      303                          FLTMX(IBALN) = ( (LTAPMC(IBALN)/JACOBN)*DXPH                   G0001370
                                                    +(LDFSPC(IBALN)/JACOBN)*DXMC )                  G0001380
ISN      304                          FLTMY(IBALN) = ( (LTAPMC(IBALN)/JACOBN)*DYPH                   G0001390
                                                    +(LDFSPC(IBALN)/JACOBN)*DYMC )                  G0001400
ISN      305                          FLTMXY(IBALN) = ( COSTHT(I)*FLTMX(IBALN)                       G0001410
                                                      +SINTHT(I)*FLTMY(IBALN) )                     G0001420
ISN      306          620           CONTINUE                                                         G0001430
ISN      307                        CFACTR=COSTHT(I)                                                 G0001440
ISN      308                        SFACTR=SINTHT(I)                                                 G0001450
                    C                 THE CONVECTIVE ENTHALPY TERMS ARE ADDED BELOW.                G0001460
ISN      309                      END IF                                                             G0001470
                    C                                                                               G0001480
ISN      310                    IF (EDGOR(JEDGEJ).EQ.HORZ) THEN                                      G0001490
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                    *....*...1.........2.........3.........4.........5.........6.........7.*.......8

                    C                   CASE 6H: THE INTERIOR EDGE IS HORIZONTAL.                   G0001500
ISN      311                        DR=TWO*DRPHH(J)                                                  G0001510
ISN      312                        DTH=DTHTAP(IM)                                                   G0001520
ISN      313                        IF (CSYSTM.EQ.CYLN) THEN                                         G0001530
ISN      314                          FDISAV=HALF*(FRNDIS(IP)+FRNDIS(IM))                            G0001540
ISN      315                          DFRNDO=(FRNDIS(IP)-FRNDIS(IM))/DTH                             G0001550
ISN      316                          DXDO=GLINER(J)*(DFRNDO*COSIMA(IP)-FDISAV*SINIMA(IP))           G0001560
ISN      317                          DYDO=GLINER(J)*(DFRNDO*SINIMA(IP)+FDISAV*COSIMA(IP))           G0001570
ISN      318                          DXDR=FDISAV*COSIMA(IP)                                         G0001580
ISN      319                          DYDR=FDISAV*SINIMA(IP)                                         G0001590
                    C                   EQUATION (I.3) AT I+1/2,J.                                  G0001600
ISN      320                          JACOBN=GLINER(J)*FDISAV**2                                     G0001610
ISN      321                        END IF                                                           G0001620
ISN      322                        IF (CSYSTM.EQ.SPHR) THEN                                         G0001630
ISN      323                          FDISAV=HALF*(FRNDIS(IP)+FRNDIS(IM))                            G0001640
ISN      324                          DFRNDO=(FRNDIS(IP)-FRNDIS(IM))/DTH                             G0001650
ISN      325                          DXDO=GLINER(J)*(DFRNDO*COSIMA(IP)-FDISAV*SINIMA(IP))           G0001660
ISN      326                          DYDO=GLINER(J)*(DFRNDO*SINIMA(IP)+FDISAV*COSIMA(IP))           G0001670
ISN      327                          DXDR=FDISAV*COSIMA(IP)                                         G0001680
ISN      328                          DYDR=FDISAV*SINIMA(IP)                                         G0001690
                    C                   EQUATION (I.3) AT I+1/2,J.                                  G0001700
ISN      329                          JACOBN=GLINER(J)*FDISAV**2                                     G0001710
ISN      330                        END IF                                                           G0001720
ISN      331                        IF (TEST) THEN                                                   G0001730
ISN      332                          SJACBN=DXDR*DYDO-DYDR*DXDO                                     G0001740
                    C                                                                               G0001750
ISN      333                          CALL COMPAR(702,0,JACOBN,SJACBN,1.0D-4)                        G0001760
                    C                 I.E. CALL COMPAR(ICHECK,JFP,X,Y,ATOL)                         G0001770
ISN      334                        END IF                                                           G0001780
                    C                                                                               G0001790
ISN      335                        DO 640 IBALN=1,NBALNS                                            G0001800
                                      EQUATIONS (I.16A)                                             G0001810
                                                                                                    G0001820
                                    4.   5.   6.                                                   G0001830
                                    ------------                                                    G0001840
                                                                                                    G0001850
                                    1.   2.   3.                                                   G0001860
                                                                                                    G0001870
ISN      336                          DPHDR  = HALF*(                                                G0001880
                                              LPHIP(6,IBALN)-LPHIP(4,IBALN)                         G0001890
                                             +LPHIP(3,IBALN)-LPHIP(1,IBALN) )/DR                    G0001900
ISN      337                          DPHDTH = (LPHIP(5,IBALN)-LPHIP(2,IBALN) )/DTH                  G0001910
ISN      338                          DMCDR  = HALF*(                                                G0001920
                                              LMC(6,IBALN)-LMC(4,IBALN)                             G0001930
                                             +LMC(3,IBALN)-LMC(1,IBALN) )/DR                        G0001940
ISN      339                          DMCDTH = (LMC(5,IBALN)-LMC(2,IBALN) )/DTH                      G0001950
                    C                   EQUATIONS (I.16A) AND (I.8)                                 G0001960
ISN      340                          DXPH=-DXDO*DPHDR+DXDR*DPHDTH                                   G0001970
ISN      341                          DYPH= DYDO*DPHDR-DYDR*DPHDTH                                   G0001980
ISN      342                          DXMC=-DXDO*DMCDR+DXDR*DMCDTH                                   G0001990
ISN      343                          DYMC= DYDO*DMCDR-DYDR*DMCDTH                                   G0002000
                    C                   EQUATION (I.15)                                             G0002010
ISN      344                          FLTMX(IBALN) = ( (LTAPMC(IBALN)/JACOBN)*DXPH                   G0002020
                                                    +(LDFSPC(IBALN)/JACOBN)*DXMC )                  G0002030
ISN      345                          FLTMY(IBALN) = ( (LTAPMC(IBALN)/JACOBN)*DYPH                   G0002040
                                                                                                    G0002050
```

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                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
ISN      346          1                 FLTMXY(IBALN) = +(LDFSPC(IBALN)/JACOBN)*DYMC )                    G0002060
ISN      347          1                                 (COSIPA(IM)*FLTMX(IBALN)                          G0002070
ISN      348                                           +SINIPA(IM)*FLTMY(IBALN) )                          G0002080
ISN      349     640          CONTINUE                                                                      G0002090
                              CFACTR=COSIPA(IM)                                                             G0002100
                              SFACTR=SINIPA(IM)                                                             G0002110
                C                THE CONVECTIVE ENTHALPY TERMS ARE ADDED BELOW.                             G0002120
ISN      350                 END IF                                                                        G0002130
                C                                                                                          G0002140
ISN      351        700   CONTINUE                                                                         G0002150
                C           COMPUTE THE ENTHALPY FLOW TERMS.                                               G0002160
ISN      352               FLTMX(5)  = ( FLTMX(5)                                                         G0002170
                          1            +FLTMX(1)*ENHLNA(JUPP(1))                                           G0002180
                          2            +FLTMX(2)*ENHLOL(JUPP(2))                                           G0002190
                          3            +FLTMX(3)*ENHLOS(JUPP(3))                                           G0002200
                          4            +FLTMX(4)*ENHLOH(JUPP(4)) )                                         G0002210
ISN      353              FLTMY(5)  = ( FLTMY(5)                                                         G0002220
                          1            +FLTMY(1)*ENHLNA(JUPP(1))                                           G0002230
                          2            +FLTMY(2)*ENHLOL(JUPP(2))                                           G0002240
                          3            +FLTMY(3)*ENHLOS(JUPP(3))                                           G0002250
                          4            +FLTMY(4)*ENHLOH(JUPP(4)) )                                         G0002260
ISN      354              FLTMXY(5) = CFACTR*FLTMX(5) + SFACTR*FLTMY(5)                                  G0002270
                C                                                                                          G0002280
ISN      355              FLTMX(10) = ( ZERO                                                             G0002290
                          1            +FLTMX(6)*ENHVNA(JUPP(6))                                           G0002300
                          2            +FLTMX(7)*ENHVOL(JUPP(7))                                           G0002310
                          3            +FLTMX(8)*ENHVOS(JUPP(8)) )                                         G0002320
ISN      356              FLTMY(10) = ( ZERO                                                             G0002330
                          1            +FLTMY(6)*ENHVNA(JUPP(6))                                           G0002340
                          2            +FLTMY(7)*ENHVOL(JUPP(7))                                           G0002350
                          3            +FLTMY(8)*ENHVOS(JUPP(8)) )                                         G0002360
ISN      357              FLTMXY(10)= CFACTR*FLTMX(10) + SFACTR*FLTMY(10)                                G0002370
                CCC                                                                                        G0002380
                C            STORE THE FLOW TERMS IN THE BIG ARRAYS.                                       G0002390
ISN      358              DO 750 ICOMPO=1,NBALNS                                                         G0002400
ISN      359                 FLTMXA(ICOMPO,JEDGEJ)=FLTMX( ICOMPO)                                        G0002410
ISN      360                 FLTMYA(ICOMPO,JEDGEJ)=FLTMY( ICOMPO)                                        G0002420
ISN      361                 FLTMTA(ICOMPO,JEDGEJ)=FLTMXY(ICOMPO)                                        G0002430
ISN      362     750      CONTINUE                                                                         G0002440
                C                                                                                          G0002450
ISN      363        900 CONTINUE                                                                          G0002460
ISN      364            RETURN                                                                            G0002470
ISN      365            END                                                                               G0002480
                                                                                                           G0002490
*STATISTICS*   SOURCE STATEMENTS = 347, PROGRAM SIZE = 20492 BYTES, PROGRAM NAME = FLTMCL    PAGE:  201.
*STATISTICS*    NO DIAGNOSTICS GENERATED.
**FLTMCL** END OF COMPILATION 40 **
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OPTIONS IN EFFECT:  NOLIST NOMAP NOXREF NOGOSTMT NODECK   SOURCE    TERM NOOBJECT FIXED  NOTEST   TRMFLG   SRCFLG
                    NOSYM NOREENT   SDUMP AUTODBL(NONE)    NOSXM    IL
                      OPT(0) LANGLVL(77) NOFIPS   FLAG(I)  NAME(MAIN   )  LINECOUNT(60)      CHARLEN(500)
                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
                C.FLSCCL
                CC  500.  CALCULATE FLOW TERMS IN ONE SECTOR OF THE CENTRE GRID BLOCK.                     G0002500
                CCC                                                                                        G0002510
                C                                                                                          G0002520
ISN        1          SUBROUTINE FLSCCL(L2SYMM,NBALNS,NOMAX,NOS,JO,CENDIS,                               G0002530
                     1                  XIRING,YIRING,LTAPMC,LPHIP,LDFSPC,LMC,                         G0002540
                     2                  FLTMX,FLTMY)                                                   G0002550
ISN        2          IMPLICIT DOUBLE PRECISION (A-H,K,O-Z)                                              G0002560
                C                                                                                          G0002570
ISN        3          LOGICAL L2SYMM                                                                     G0002580
ISN        4          DOUBLE PRECISION XIRING(NOMAX) ,YIRING(NOMAX)                                      G0002590
ISN        5          DOUBLE PRECISION LTAPMC(NBALNS),LPHIP(6,NBALNS)                                    G0002600
ISN        6          DOUBLE PRECISION LDFSPC(NBALNS),LMC(6,NBALNS)                                      G0002610
ISN        7          DOUBLE PRECISION FLTMX( NBALNS),FLTMY(NBALNS)                                      G0002620
                CC                                                                                         G0002630
ISN        8          COMMON/BASICS/ZERO,HALF,ONE,TWO                                                    G0002640
                                                                                                           G0002650
                C     PAGE 1A                                                                              G0002660
                C      INPUT SCALARS: JO,L2SYMM,NOS,ZERO,CENDIS                                            G0002670
                C      INPUT  ARRAYS: XIRING,YIRING                                                        G0002680
                C                                                                                          G0002690
                C     PAGE 1B                                                                              G0002700
                C      NOTHING NEW                                                                         G0002710
                C                                                                                          G0002720
                C     PAGE 2A                                                                              G0002730
                C      INPUT SCALAR : HALF                                                                 G0002740
                C                                                                                          G0002750
                C     PAGE 2B                                                                              G0002760
                C      INPUT SCALAR : NBALNS                                                               G0002770
                C      INPUT  ARRAYS: LPHIP,LMC,LTAPMC,LDFSPC                                              G0002780
                C     OUTPUT  ARRAYS: FLTMX,FLTMY                                                          G0002790
                C                                                                                          G0002800
                C           THE BASIC BUILDING BLOCK OF THIS SUBROUTINE IS A METHOD                        G0002810
                C           FOR INTERPOLATING A FUNCTION OF TWO VARIABLES BETWEEN                          G0002820
                C           THREE POINTS.                                                                  G0002830
                C                                                                                          G0002840
                C           TO INTERPOLATE A FUNCTION BETWEEN THREE POINTS,                                G0002850
                C           SOLVE A SYSTEM OF LINEAR EQUATIONS:                                            G0002860
                C                                                                                          G0002870
                C              F1 = CC + CX*X1 + CY*Y1                                                     G0002880
                C              F2 = CC + CX*X2 + CY*Y2                                                     G0002890
                C              F3 = CC + CX*X3 + CY*Y3                                                     G0002900
                C                                                                                          G0002910
                C           WHICH REDUCES TO                                                               G0002920
                C                                                                                          G0002930
                C              F2 - F1 = CX*(X2-X1) + CY*(Y2-Y1)                                           G0002940
                C              F3 - F1 = CX*(X3-X1) + CY*(Y3-Y1)                                           G0002950
                C                                                                                          G0002960
                C           WHICH HAS AS SOLUTION                                                          G0002970
                C                                                                                          G0002980
                C              CX = DETM1/DET                                                              G0002990
                                                                                                           G0003000
                                                                                                           G0003010
```

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                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
                C
                C           CY = DETN2/DET                                                    G0003020
                C                                                                             G0003030
                C        WHERE                                                                G0003040
                C                                                                             G0003050
                C           DET  = (X2-X1)*(Y3-Y1) - (X3-X1)*(Y2-Y1)                          G0003060
                C           DETN1 = (F2-F1)*(Y3-Y1) - (F3-F1)*(Y2-Y1)                         G0003070
                C           DETN2 = (X2-X1)*(F3-F1) - (X3-X1)*(F2-F1)                         G0003080
                C                                                                             G0003090
                C        HOWEVER, SINCE THERE USUALLY TWO TRIANGLES,                          G0003100
                C        BUT OCCASIONALLY ONLY ONE TRIANGLE,                                  G0003110
                C        THE CALCULATIONS ARE MORE COMPLICATED.                               G0003120
                C                                                                             G0003130
                C                                                                             G0003140
                C        CALCULATE THE WEIGHTS FOR THE "MINUS-SIDE" TRIANGLE.                 G0003150
                C        IF THERE IS ONE.                                                     G0003160
ISN       9           IF (JO.GT.1.OR..NOT.L2SYMM) THEN                                        G0003170
ISN      10              IF (JO.EQ.1) JOM=NOS                                                 G0003180
ISN      12              IF (JO.GT.1) JOM=JO-1                                                G0003190
                C           YES, JO CAN EQUAL 1 HERE, PROVIDED THAT L2SYMM IS FALSE.          G0003200
ISN      14              X1=ZERO                                                              G0003210
ISN      15              Y1=CENDIS                                                            G0003220
ISN      16              X2=XIRING(JOM)                                                       G0003230
ISN      17              Y2=YIRING(JOM)                                                       G0003240
ISN      18              X3=XIRING(JO)                                                        G0003250
ISN      19              Y3=YIRING(JO)                                                        G0003260
                C              HERE, F1 IS LPHIP(2,IBALN) OR LHC(2,IBALN);                    G0003270
                C                  F2 IS LPHIP(4,IBALN) OR LHC(4,IBALN);                      G0003280
                C              AND F3 IS LPHIP(5,IBALN) OR LHC(5,IBALN).                      G0003290
ISN      20              DETM = (X2-X1)*(Y3-Y1) - (X3-X1)*(Y2-Y1)                             G0003300
ISN      21              M4XM =  (Y3-Y1)/DETM                                                 G0003310
ISN      22              M5XM = -(Y2-Y1)/DETM                                                 G0003320
ISN      23              M4YM = -(X3-X1)/DETM                                                 G0003330
ISN      24              M5YM =  (X2-X1)/DETM                                                 G0003340
ISN      25            END IF                                                                 G0003350
                C                                                                             G0003360
                C        CALCULATE THE WEIGHTS FOR THE "PLUS-SIDE" TRIANGLE.                  G0003370
                C        IF THERE IS ONE.                                                     G0003380
ISN      26        IF (JO.LT.NOS.OR..NOT.L2SYMM) THEN                                        G0003390
ISN      27           IF (JO.EQ.NOS) JOP=1                                                   G0003400
ISN      29           IF (JO.LT.NOS) JOP=JO+1                                                G0003410
                C           YES, JO CAN EQUAL NOS HERE, PROVIDED THAT L2SYMM IS FALSE.        G0003420
ISN      31              X1=ZERO                                                              G0003430
ISN      32              Y1=CENDIS                                                            G0003440
ISN      33              X2=XIRING(JO)                                                        G0003450
ISN      34              Y2=YIRING(JO)                                                        G0003460
ISN      35              X3=XIRING(JOP)                                                       G0003470
ISN      36              Y3=YIRING(JOP)                                                       G0003480
                C              HERE, F1 IS LPHIP(2,IBALN) OR LHC(2,IBALN);                    G0003490
                C                  F2 IS LPHIP(5,IBALN) OR LHC(5,IBALN);                      G0003500
                C              AND F3 IS LPHIP(6,IBALN) OR LHC(6,IBALN).                      G0003510
ISN      37              DETP = (X2-X1)*(Y3-Y1) - (X3-X1)*(Y2-Y1)                             G0003520
ISN      38              M5XP =  (Y3-Y1)/DETP                                                 G0003530
ISN      39              M6XP = -(Y2-Y1)/DETP                                                 G0003540
ISN      40              M5YP = -(X3-X1)/DETP                                                 G0003550
ISN      41              M6YP =  (X2-X1)/DETP                                                 G0003560
ISN      42            END IF                                                                 G0003570
```



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                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
                C                                                                             G0003580
                C        COMBINE THE WEIGHTS FOR THE TWO TRIANGLES                            G0003590
                C        INTO ONE SET OF WEIGHTS.                                             G0003600
ISN      43        IF (L2SYMM.AND.(JO.EQ.1.OR.JO.EQ.NOS)) THEN                               G0003610
ISN      44           IF (JO.EQ.1) THEN                                                      G0003620
ISN      45              M4X=ZERO                                                            G0003630
ISN      46              M4Y=ZERO                                                            G0003640
ISN      47              M5X=M5XP                                                            G0003650
ISN      48              M5Y=M5YP                                                            G0003660
ISN      49              M6X=M6XP                                                            G0003670
ISN      50              M6Y=M6YP                                                            G0003680
ISN      51            END IF                                                                G0003690
ISN      52           IF (JO.EQ.NOS) THEN                                                    G0003700
ISN      53              M4X=M4XM                                                            G0003710
ISN      54              M4Y=M4YM                                                            G0003720
ISN      55              M5X=M5XM                                                            G0003730
ISN      56              M5Y=M5YM                                                            G0003740
ISN      57              M6X=ZERO                                                            G0003750
ISN      58              M6Y=ZERO                                                            G0003760
ISN      59            END IF                                                                G0003770
ISN      60         ELSE                                                                     G0003780
ISN      61           M4X=HALF*M4XM                                                          G0003790
ISN      62           M4Y=HALF*M4YM                                                          G0003800
ISN      63           M5X=HALF*(M5XM+M5XP)                                                   G0003810
ISN      64           M5Y=HALF*(M5YM+M5YP)                                                   G0003820
ISN      65           M6X=HALF*M6XP                                                          G0003830
ISN      66           M6Y=HALF*M6YP                                                          G0003840
ISN      67         END IF                                                                   G0003850
                C                                                                             G0003860
                C        NOW CALCULATE THE FLOW TERMS, BALANCE BY BALANCE.                    G0003870
ISN      68        DO 120 IBALN=1,NBALNS                                                     G0003880
ISN      69           DELPH4=LPHIP(4,IBALN)-LPHIP(2,IBALN)                                   G0003890
ISN      70           DELPH5=LPHIP(5,IBALN)-LPHIP(2,IBALN)                                   G0003900
ISN      71           DELPH6=LPHIP(6,IBALN)-LPHIP(2,IBALN)                                   G0003910
ISN      72           DPHDX=M4X*DELPH4+M5X*DELPH5+M6X*DELPH6                                 G0003920
ISN      73           DPHDY=M4Y*DELPH4+M5Y*DELPH5+M6Y*DELPH6                                 G0003930
                C                                                                             G0003940
ISN      74           DELHC4=LHC(4,IBALN)-LHC(2,IBALN)                                       G0003950
ISN      75           DELHC5=LHC(5,IBALN)-LHC(2,IBALN)                                       G0003960
ISN      76           DELHC6=LHC(6,IBALN)-LHC(2,IBALN)                                       G0003970
ISN      77           DHCDX=M4X*DELHC4+M5X*DELHC5+M6X*DELHC6                                 G0003980
ISN      78           DHCDY=M4Y*DELHC4+M5Y*DELHC5+M6Y*DELHC6                                 G0003990
                C                                                                             G0004000
ISN      79           FLTHX(IBALN)=-(LTAPHC(IBALN)*DPHDX+LDFSPC(IBALN)*DHCDX)                G0004010
ISN      80           FLTHY(IBALN)=-(LTAPHC(IBALN)*DPHDY+LDFSPC(IBALN)*DHCDY)                G0004020
ISN      81     120 CONTINUE                                                                 G0004030
                C                                                                             G0004040
ISN      82        RETURN                                                                    G0004050
ISN      83        END                                                                       G0004060
*STATISTICS*  SOURCE STATEMENTS = 79, PROGRAM SIZE = 4248 BYTES, PROGRAM NAME = FLSCCL    PAGE:  212.
*STATISTICS*   NO DIAGNOSTICS GENERATED.
**FLSCCL** END OF COMPILATION 41 ******
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OPTIONS IN EFFECT:  NOLIST NOMAP NOXREF NOGOSTMT NODECK   SOURCE    TERM NOOBJECT FIXED  NOTEST   TRMFLG   SRCFLG
                    NOSYM NORENT   SDUMP AUTODBL(NONE)   NOSXM    IL
                      OPT(0) LANGLVL(77) NOFIPS    FLAG(I)   NAME(MAIN   )  LINECOUNT(60)      CHARLEN(500)

                 *....*...1.........2.........3.........4.........5.........6.........7.*.......8
                  C.COMPAR
                  C                                                                              G0004070
                  C  SOO.  COMPARE WHETHER TWO NUMBERS ARE 'ALMOST' EQUAL.                       G0004080
                  C                                                                              G0004090
ISN         1         SUBROUTINE COMPAR(ICHECK,JFP,X,Y,ATOL)                                     G0004100
ISN         2         IMPLICIT DOUBLE PRECISION (A-H,K,O-Z)                                      G0004110
                  C                                                                              G0004120
                  C                                                                              G0004130
                  C                                                                              G0004140
                  C                                                                              G0004150
ISN         3       101 FORMAT(' ****** DISCREPANCY AT CHECKPOINT',I3,' ,JFP=',I3,               G0004160
                    1   ' BETWEEN ',D15.6,' AND ',D15.6)                                       G0004170
ISN         4         IF (DABS(X-Y).GT.ATOL*(1.+DABS(X)+DABS(Y)))                              G0004180
                    1 WRITE(6,101)ICHECK,JFP,X,Y                                               G0004190
ISN         6         RETURN                                                                   G0004200
ISN         7         END                                                                      G0004210
                                                                                               G0004220
*STATISTICS*   SOURCE STATEMENTS = 6, PROGRAM SIZE = 892 BYTES, PROGRAM NAME = COMPAR    PAGE:  215.

*STATISTICS*    NO DIAGNOSTICS GENERATED.

**COMPAR** END OF COMPILATION 42 ******
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OPTIONS IN EFFECT:  NOLIST NOMAP NOXREF NOGOSTMT NODECK   SOURCE    TERM NOOBJECT FIXED  NOTEST   TRMFLG   SRCFLG
                    NOSYM NORENT   SDUMP AUTODBL(NONE)   NOSXM    IL
                      OPT(0) LANGLVL(77) NOFIPS    FLAG(I)   NAME(MAIN   )  LINECOUNT(60)      CHARLEN(500)

                 *....*...1.........2.........3.........4.........5.........6.........7.*.......8
                  C.HLLSSQ
                  C                                                                              G0004230
                  C  SOO.  USE LINEAR LEAST SQUARES TO CALCULATE FLOW GRADIENTS                  G0004240
                  C        FOR THE CENTRE GRID BLOCK.                                            G0004250
                  C                                                                              G0004260
ISN         1         SUBROUTINE HLLSSQ(NOMAX,NOS,NBALNS,                                        G0004270
                    1                 XIRING,YIRING,FTMXCN,FTMYCN,                             G0004280
                    2                 DXCFL,DYCFL)                                             G0004290
ISN         2         IMPLICIT DOUBLE PRECISION (A-H,K,O-Z)                                      G0004300
                  C                                                                              G0004310
ISN         3         DOUBLE PRECISION FTMXCN(NBALNS,NOMAX),FTMYCN(NBALNS,NOMAX)                 G0004320
ISN         4         DOUBLE PRECISION DXCFL(NBALNS),DYCFL(NBALNS)                               G0004330
ISN         5         DOUBLE PRECISION XIRING(NOMAX),YIRING(NOMAX)                               G0004340
                  C                                                                              G0004350
ISN         6         LOGICAL L2SYMH,LCIRCL                                                      G0004360
                  C                                                                              G0004370
ISN         7         COMMON/BASICS/ZERO,HALF,ONE,TWO                                            G0004380
ISN         8         COMMON/LOGSYM/L2SYMH,LCIRCL                                                G0004390
                  C                                                                              G0004400
                  C PAGE 1B                                                                      G0004410
                  C  INPUT SCALARS: L2SYMH,NOS,ZERO                                              G0004420
                  C                                                                              G0004430
                  C PAGE 2A                                                                      G0004440
                  C  INPUT SCALARS: HALF,ONE                                                     G0004450
                  C  INPUT  ARRAYS: XIRING,YIRING                                                G0004460
                  C                                                                              G0004470
                  C PAGE 2B                                                                      G0004480
                  C  INPUT SCALAR : NBALNS                                                       G0004490
                  C  INPUT  ARRAYS: FTMXCN,FTMYCN                                                G0004500
                  C OUTPUT  ARRAYS: DXCFL,DYCFL                                                  G0004510
                  C                                                                              G0004520
                  C                                                                              G0004530
                  C       THE PLAN: FIRST CALCULATE THE COEFFICIENTS WHICH DEPEND                 G0004540
                  C       ONLY ON THE LOCATIONS OF THE FIRST RING OF GRID POINTS.                 G0004550
                  C       THEN, CALCULATE FITS FOR EACH BALANCE.                                 G0004560
                  C                                                                              G0004570
                  C       CALCULATE A,B TO FIT  H = A + B*T .                                    G0004580
                  C                                                                              G0004590
                  C       SOLVE   SUM1 * A + SUMT  * B  =  SUMH                                  G0004600
                  C               SUMT * A + SUMTT * B  =  SUMTH                                 G0004610
                  C                                                                              G0004620
ISN         9         IF (L2SYMH) THEN                                                           G0004630
                  C       EXCLUDE THE FICTITIOUS POINTS FROM THE FIT.                            G0004640
ISN        10           JOSTA=2                                                                 G0004650
ISN        11           JOFIN=NOS-1                                                             G0004660
ISN        12         ELSE                                                                      G0004670
ISN        13           JOSTA=1                                                                 G0004680
ISN        14           JOFIN=NOS                                                               G0004690
ISN        15         END IF                                                                    G0004700
                  C                                                                              G0004710
ISN        16         SUMXX=ZERO                                                              G0004720
ISN        17         SUMX =ZERO                                                              G0004730
                                                                                               G0004740
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                *....*...1.....2.....3.....4.....5.....6.....7.*.....8
ISN        18           SUMYY=ZERO                                                    G0004750
ISN        19           SUMY =ZERO                                                    G0004760
ISN        20           SUM1 =ZERO                                                    G0004770
                C                                                                    G0004780
                CCC      DO 120 I=ISTART,IFINIS  WAS DELETED.                        G0004790
                CCC         XCEN(I)=(HALF*GLINER(2)*FRNDIS(I))*COSTHT(I)  WAS DELETED. G0004800
                CCC         YCEN(I)=(HALF*GLINER(2)*FRNDIS(I))*SINTHT(I)-CENDIS  DELETED. G0004810
                C 120 CONTINUE  WAS DELETED.                                         G0004820
ISN        21           DO 140 JO=JOSTA,JOFIN                                       G0004830
ISN        22              SUMXX=SUMXX+XTRING(JO)*XIRING(JO)                        G0004840
ISN        23              SUMX =SUMX +XIRING(JO)                                   G0004850
ISN        24              SUMYY=SUMYY+YIRING(JO)*YIRING(JO)                        G0004860
ISN        25              SUMY =SUMY +YIRING(JO)                                   G0004870
ISN        26              SUM1 =SUM1 +ONE                                          G0004880
ISN        27           140 CONTINUE                                                G0004890
ISN        28           DETX=SUMXX*SUM1-SUMX*SUMX                                   G0004900
ISN        29           DETY=SUMYY*SUM1-SUMY*SUMY                                   G0004910
                CCC                                                                  G0004920
                CCC         A = (SUMTT*SUMSH -SUMT*SUMTH)/DET                        G0004930
                CCC         B = (SUM1 *SUMTH-SUMT*SUMSH )/DET                        G0004940
                CCC                                                                  G0004950
                C        CXA1= SUMXX/DETX  IS NOT NEEDED.                            G0004960
                C        CXA2=-SUMX /DETX  IS NOT NEEDED.                            G0004970
ISN        30           CXB1=-SUMX /DETX                                            G0004980
ISN        31           CXB2= SUM1 /DETX                                            G0004990
                C        CYA1= SUMYY/DETY  IS NOT NEEDED.                            G0005000
                C        CYA2=-SUMY /DETY  IS NOT NEEDED.                            G0005010
ISN        32           CYB1=-SUMY /DETY                                            G0005020
ISN        33           CYB2= SUM1 /DETY                                            G0005030
                C                                                                    G0005040
                CCC                                                                  G0005050
                CCC      NOW CALCULATE A LINEAR FIT FOR EACH BALANCE.                G0005060
                CCC                                                                  G0005070
ISN        34           DO 290 IBALN=1,NBALNS                                       G0005080
ISN        35              XSUMXF=ZERO                                              G0005090
ISN        36              YSUMYF=ZERO                                              G0005100
ISN        37              XSUMF =ZERO                                              G0005110
ISN        38              YSUMF =ZERO                                              G0005120
ISN        39              DO 250 JO=JOSTA,JOFIN                                    G0005130
ISN        40                 XSUMXF=XSUMXF+XIRING(JO)*FTMXCN(IBALN,JO)             G0005140
ISN        41                 YSUMYF=YSUMYF+YIRING(JO)*FTMYCN(IBALN,JO)             G0005150
ISN        42                 XSUMF =XSUMF +FTMXCN(IBALN,JO)                        G0005160
ISN        43                 YSUMF =YSUMF +FTMYCN(IBALN,JO)                        G0005170
ISN        44           250   CONTINUE                                             G0005180
                C           AX=CXA1*XSUMF+CXA2*XSUMXF  IS NOT NEEDED.               G0005190
                C           AY=CYA1*YSUMF+CYA2*YSUMYF  IS NOT NEEDED.               G0005200
ISN        45           BX=CXB1*XSUMF+CXB2*XSUMXF                                   G0005210
ISN        46           BY=CYB1*YSUMF+CYB2*YSUMYF                                   G0005220
ISN        47           DXCFL(IBALN)=BX                                             G0005230
ISN        48           DYCFL(IBALN)=BY                                             G0005240
ISN        49        290 CONTINUE                                                   G0005250
                C                                                                    G0005260
ISN        50           RETURN                                                      G0005270
ISN        51           END                                                         G0005280
*STATISTICS*   SOURCE STATEMENTS = 51, PROGRAM SIZE = 2832 BYTES, PROGRAM NAME = HLLSSQ   PAGE:  216.
```



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*STATISTICS*    NO DIAGNOSTICS GENERATED.
**HLLSSQ** END OF COMPILATION 43 ******
```

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OPTIONS IN EFFECT:  NOLIST NOMAP NOXREF NOGOSTMT NODECK  SOURCE  TERM NOOBJECT FIXED  NOTEST  TRMFLG  SRCFLG
                    NOSYM NORENT  SDUMP AUTODBL(NONE)  NOSXM  IL
                      OPT(0) LANGLVL(77) NOFIPS  FLAG(I)  NAME(MAIN  ) LINECOUNT(60)      CHARLEN(500)

                 *....*...1.....2.....3.....4.....5.....6.....7.*.....8
                 C.SRCECL                                                                          G0005290
                 C                                                                                 G0005300
                 C  SOO.  CALCULATE THE STRENGTHS AND LOCATIONS OF THE SOURCE TERMS.               G0005310
                 C                                                                                 G0005320
ISN        1           SUBROUTINE SRCECL(LCSPLT,LCSCTM,TEST,                                      G0005330
                    1                NMELMX,NDIRMX,NBALNS,                                        G0005340
                    2                SPLIT,SRCETM)                                                G0005350
ISN        2           IMPLICIT DOUBLE PRECISION (A-H,K,O-Z)                                      G0005360
                 C                                                                                 G0005370
ISN        3           LOGICAL LCSPLT,LCSCTM,TEST                                                 G0005380
ISN        4           DOUBLE PRECISION MOBNAT,MOBHCB,MOBVAP,MOBTOT                               G0005390
ISN        5           DOUBLE PRECISION SPLIT(NDIRMX,NMELMX),SRCETM(NBALNS,NDIRMX,NMELMX)         G0005400
ISN        6           DOUBLE PRECISION SRTMII(10)                                                G0005410
                 C                                                                                 G0005420
ISN        7           DOUBLE PRECISION LAMBDA                                                    G0005430
ISN        8           LOGICAL LFRNT                                                              G0005440
ISN        9           LOGICAL RCOND,INJECT                                                       G0005450
ISN       10           INTEGER EOSIGN                                                             G0005460
ISN       11           LOGICAL L2SYMM,LCIRCL                                                      G0005470
                 C                                                                                 G0005480
ISN       12           COMMON/PVAPOR/PNAT(55),POIL(55),PSOL(55),DPNAT(55),DPOIL(55),              G0005490
                    1                DPSOL(55),DPDT(55),YMOLE(4,55),YO(55),YV(55),YS(55)       G0005500
ISN       13           COMMON/INJSPC/PGRDNT,TOTINJ,VAPINJ(28),HCBINJ(28),WATINJ(28),              G0005510
                    1                VLCTY,HC1INJ(28),HC2INJ(28),HC3INJ(28),                   G0005520
                    2                VO1INJ(28),VO2INJ(28),VWATINJ(28)                         G0005530
ISN       14           COMMON/STATEV/SMP(55),SGP(55),SOP(55),T(55),P(55),                         G0005540
                    1                XMOLE(3,55),XO(55),XSOL(55),XN(55)                        G0005550
ISN       15           COMMON/FLUPRO/DMP(55),DOP(55),DGP(55),UMP(55),UOP(55),UGP(55),             G0005560
                    1                CMP(55),COP(55),CGP(55),KO(55),KSOL(55),LAMBDA(55),       G0005570
                    2                DENSOL(55),DENSON(55),DENSOS(55),                         G0005580
                    3                DFSPCH(55),DFSPCO(55),DFSPCV(55),GASCON                   G0005590
ISN       16           COMMON/RESPRO/KA,KC(55),PHI(55),DRCB(55),PCAPW(55),PCAPV(55)               G0005600
ISN       17           COMMON/PRM123/KRGP(55),KROP(55),KRWP(55),AKROG(55),AKROW(55)               G0005610
ISN       18           COMMON/ENHLPY/ENHLMA(55),ENHVMA(55),ENHLOS(55),ENHVOS(55),                 G0005620
                    1                ENHLOL(55),ENHVOL(55),ENHLOH(55),                         G0005630
                    2                ENHMP(55),ENHOP(55),ENHVP(55),                            G0005640
                    3                ENHMPH,ENHWPH,ENHOPH,ENHOPH,ENHVPH                        G0005650
ISN       19           COMMON/BASICS/ZERO,HALF,ONE,TWO                                            G0005660
ISN       20           COMMON/DIMENS/NDIMNS,NX,NY,NOS,NRS,NRFM,NRFP                               G0005670
ISN       21           COMMON/TABL1A/LFRNT(55)                                                    G0005680
ISN       22           COMMON/SPEC4 /RCOND(28),INJECT(28)                                         G0005690
ISN       23           COMMON/BVOLFL/BVFLOW(28),FLFR(150)                                         G0005700
ISN       24           COMMON/EDSMAL/NDIRS,NEDGES,EDSIGN(8)                                       G0005710
ISN       25           COMMON/LOGSYM/L2SYMM,LCIRCL                                                G0005720
ISN       26           COMMON/IJTBIJ/IOFGRP(55),JOFGRP(55),JGRPIJ(36,24)                          G0005730
ISN       27           COMMON/GLINEC/GLINEO(36),GLINER(24)                                        G0005740
ISN       28           COMMON/DGRID /DTHTAM(36),DTHTAP(36),DOPHMH(36),DTHETA(36),                 G0005750
                    1                DFOMTH(36),DFOMTP(36),                                    G0005760
                    2                DRPHMH(24),DRADM1(24),DRADP1(24)                          G0005770
ISN       29           COMMON/FRNTCF/DCENDS,CENDIS,FRNDIS(36),DFRDTH(36),FRFRTH(36),              G0005780
                    1                VFDOTH(36),XIRING(36),YIRING(36)                          G0005790
ISN       30           COMMON/WELLXY/XWELL(11),YWELL(11)                                          G0005800
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                 *....*...1.....2.....3.....4.....5.....6.....7.*.....8
ISN       31           COMMON/WELLJ1/NWELLS,IENTWO(11),IENTWR(11),JGNEAR(11),                     G0005810
                    1                JNELOC(55)                                                G0005820
ISN       32           COMMON/WELLJ2/JGPSC(8,11)                                                  G0005830
                 CCCCC                                                                             G0005840
                 CCCCC  PAGE1A                                                                     G0005850
                 CCCCC   INPUT SCALARS: LCSPLT,NWELLS,CENDIS                                       G0005860
                 CCCCC   INPUT  ARRAYS: XWELL,YWELL                                                G0005870
                 CCCCC                                                                             G0005880
                 CCCCC  PAGE1B                                                                     G0005890
                 CCCCC   INPUT  ARRAYS: IENTWO,FRNDIS,GLINEO,IENTWR,GLINER                         G0005900
                 CCCCC                                                                             G0005910
                 CCCCC  PAGE 2B                                                                    G0005920
                 CCCCC   INPUT SCALARS: L2SYMM,TEST                                                G0005930
                 CCCCC   INPUT  ARRAYS: JGRPIJ,JGPSC,LCSCTM,BVFLOW,INJECT,                         G0005940
                 CCCCC                  WATINJ,HCBINJ,VAPINJ,HC1INJ,HC2INJ,HC3INJ                  G0005950
                 CCCCC   LOCAL  ARRAY : SRTMII                                                     G0005960
                 CCCCC  OUTPUT  ARRAY : SPLIT                                                      G0005970
                 CCCCC                                                                             G0005980
                 CCCCC  PAGE 3A                                                                    G0005990
                 CCCCC   INPUT SCALARS: ZERO,KA                                                    G0006000
                 CCCCC   INPUT  ARRAYS: VWATINJ,VO1INJ,VO2INJ,KRWP,KROP,KRGP,UWP,UOP,UGP,         G0006010
                 CCCCC                  DWP,DOP,DGP,XMOLE,YMOLE,                                   G0006020
                 CCCCC                  ENHLMA,ENHLOL,ENHLOS,ENHLOH,ENHVMA,ENHVOL,ENHVOS           G0006030
                 CCCCC                                                                             G0006040
                 CCCCC  PAGE 3B                                                                    G0006050
                 CCCCC   INPUT SCALAR : NBALNS                                                     G0006060
                 CCCCC  OUTPUT  ARRAY : SRCETM                                                     G0006070
                 CCCCC                                                                             G0006080
ISN       33           IF (LCSPLT) THEN                                                           G0006090
ISN       34              DO 460 IWELL=1,NWELLS                                                   G0006100
ISN       35                 WLX=XWELL(IWELL)                                                     G0006110
ISN       36                 WLY=YWELL(IWELL)                                                     G0006120
ISN       37                 WLYBAR=WLY-CENDIS                                                    G0006130
ISN       38                 WLO=DATAN2(WLYBAR,WLX)                                               G0006140
                 CCCCCCC               THETA VARIES BETWEEN -PI AND +PI.  DATAN2 IS A            G0006150
                 CCCCCCC               BUILT-IN FUNCTION FOR CALCULATING ARCTAN(WLYBAR/WLX).     G0006160
                 CCCCCCC                                                                          G0006170
                 CCCCCCC               WE NEED IENTWO IN ORDER TO CALCULATE WLR.                  G0006180
                 CCCCCCC               THIS FACT MAKES THIS PROGRAM SECTION SOMEWHAT MESSY.       G0006190
ISN       39                 JE=IENTWO(IWELL)                                                     G0006200
ISN       40                 IF (JE.LT.NOS.OR.   L2SYMM   ) IEP1=JE+1                             G0006210
ISN       42                 IF (JE.EQ.NOS.AND..NOT.L2SYMM) IEP1=1                                G0006220
ISN       44                 FRNDS=(FRNDIS(JE)+(FRNDIS(IEP1)-FRNDIS(JE))                          G0006230
                    1                    *(WLO-GLINEO(JE))/DTHTAP(JE) )                           G0006240
                 C REPLACES  FRNDS=(FRNDIS(IE)+(FRNDIS(IE+1)-FRNDIS(IE))                          G0006250
                 C    1                *(WLO-GLINEO(IE))/(GLINEO(IE+1)-GLINEO(IE)) )               G0006260
ISN       45                 WLR=OSQRT(WLYBAR*WLYBAR+WLX*WLX)/FRNDS                               G0006270
                 CCCCCCC                                                                          G0006280
                 CCCCCCC               CALCULATE HOW THE SOURCE TERM SPLITS                       G0006290
                 CCCCCCC               AMONG THE FOUR GRID POINTS IN JGPSC.                       G0006300
                 CCCCCCC               THE IOIR CONVENTION IS AUTOMATICALLY THE SAME AS THE ONE   G0006310
                 CCCCCCC               USED FOR JGPSC IN THE SUBROUTINE SRCUPD.                   G0006320
ISN       46                 JE=IENTWR(IWELL)                                                     G0006330
ISN       47                 DTHT=DTHTAP(JE)                                                      G0006340
                 C REPLACES  DTHT=GLINEO(IE+1)-GLINEO(IE)                                         G0006350
ISN       48                 DRT =GLINER(JE+1)-GLINER(JE)                                         G0006360
```

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                 *....*...1.........2.........3.........4.........5.........6.........7.*.......8
ISN      49                    DO 450 IDIR=1,NDIRS                                                GD0006370
ISN      50                    JGRPJ=JGPSC(IDIR,IWELL)                                            GD0006380
                C                    COMPUTE OFACTR.
ISN      51                    IF (JGRPJ.LE.1) THEN                                               GD0006390
ISN      52                      OFACTR=HALF                                                      GD0006400
ISN      53                    ELSE                                                               GD0006410
ISN      54                      IG=IOFGRP(JGRPJ)                                                 GD0006420
                C                    TO ALLOW FOR RING TOPOLOGY:                                  GD0006430
ISN      55                      IF (IG.LT.IE.AND..NOT.L2SYMM) IG=IE+1                            GD0006440
ISN      57                      IF (IG.EQ.IE   ) OFACTR=(GLINEO(IE)+DTHT-HLO)/DTHT               GD0006450
ISN      59                      IF (IG.EQ.IE+1) OFACTR=(   HLO-GLINEO(IE)    )/DTHT              GD0006460
                C                    TO KEEP OFACTR BETWEEN 0 AND 1, INCLUSIVE:                   GD0006470
ISN      61                      OFACTR=DMAX1(ZERO,DMIN1(ONE,OFACTR))                             GD0006480
ISN      62                    END IF                                                             GD0006490
                C                    COMPUTE RFACTR.                                              GD0006500
ISN      63                    JG=JOFGRP(JGRPJ)                                                   GD0006510
ISN      64                    IF (IABS(JE-NREFM).LE.1) THEN                                      GD0006520
ISN      65                      IF (     LFRNT(JGRPJ)) RFACTR=ZERO                               GD0006530
ISN      67                      IF (.NOT.LFRNT(JGRPJ)) RFACTR=ONE                               GD0006540
ISN      69                    ELSE                                                               GD0006550
ISN      70                      IF (JG.EQ.JE   ) RFACTR=(GLINER(JE)+DRT -HLR)/DRT                GD0006560
ISN      72                      IF (JG.EQ.JE+1) RFACTR=(   HLR-GLINER(JE)    )/DRT               GD0006570
ISN      74                    END IF                                                             GD0006580
                C                    TO KEEP RFACTR BETWEEN 0 AND 1, INCLUSIVE:                   GD0006590
ISN      75                    RFACTR=DMAX1(ZERO,DMIN1(ONE,RFACTR))                               GD0006600
                C                                                                                 GD0006610
ISN      76                    SPLIT(IDIR,IWELL)=OFACTR*RFACTR                                    GD0006620
ISN      77                    IF (TEST) THEN                                                     GD0006630
ISN      78       445            FORMAT(' ***+++ SRCECL ERROR (THETA):',4I3)                     GD0006640
ISN      79       446            FORMAT(' ***+++ SRCECL ERROR (  R  ):',4I3)                     GD0006650
ISN      80                      IF (IG.NE.IE.AND.IG.NE.IE+1.AND.JGRPJ.GT.1)                     GD0006660
               1                  WRITE(6,445)IWELL,IDIR,IE,IG                                   GD0006670
ISN      82                      IF (JG.NE.JE.AND.JG.NE.JE+1)                                    GD0006680
               1                  WRITE(6,446)IWELL,IDIR,JE,JG                                   GD0006690
ISN      84                    END IF                                                             GD0006700
ISN      85       450        CONTINUE                                                            GD0006710
ISN      86       460      CONTINUE                                                              GD0006720
ISN      87               END IF                                                                GD0006730
                C                                                                                 GD0006740
ISN      88           IF (LCSCTM) THEN                                                         GD0006750
                C      CALCULATE THE SOURCE TERMS, AND ADD THEM TO THE BALANCES.                  GD0006760
ISN      89             DO 490 IWELL=1,NWELLS                                                  GD0006770
ISN      90               DO 480 IDIR=1,NDIRS                                                  GD0006780
ISN      91                 JGRPJ=JGPSC(IDIR,IWELL)                                            GD0006790
ISN      92                 VFL=BVFLOW(IWELL)*SPLIT(IDIR,IWELL)                                GD0006800
ISN      93                 IF (INJECT(IWELL)) THEN                                            GD0006810
                C                  INJECTION RATIOS ARE SPECIFIED.                              GD0006820
ISN      94                   FLOMAT=VFL*MATINJ(IWELL)*DMP(JGRPJ)                              GD0006830
ISN      95                   FLOHCB=VFL*HCBINJ(IWELL)*DOP(JGRPJ)                              GD0006840
ISN      96                   FLOVAP=VFL*VAPINJ(IWELL)*DGP(JGRPJ)                              GD0006850
ISN      97                   SRTMII(1)=FLOMAT                                                 GD0006860
ISN      98                   SRTMII(2)=FLOHCB*HC1INJ(IWELL)                                   GD0006870
ISN      99                   SRTMII(3)=FLOHCB*HC2INJ(IWELL)                                   GD0006880
ISN     100                   SRTMII(4)=FLOHCB*HC3INJ(IWELL)                                   GD0006890
                C                  SRTMII(5) IS CALCULATED LATER.                               GD0006900
ISN     101                   SRTMII(6)=FLOVAP*VMAINJ(IWELL)                                   GD0006910
```



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                 *....*...1.........2.........3.........4.........5.........6.........7.*.......8
ISN     102                   SRTMII(7)=FLOVAP*VO1INJ(IWELL)                                   GD0006930
ISN     103                   SRTMII(8)=FLOVAP*VO2INJ(IWELL)                                   GD0006940
ISN     104                   SRTMII(9)=ZERO                                                   GD0006950
                C                  SRTMII(10) IS CALCULATED LATER.                              GD0006960
                C                                                                               GD0006970
ISN     105                   ELSE                                                             GD0006980
                C                  INJECTION RATIOS ARE NOT SPECIFIED.                          GD0006990
ISN     106                   MOBMAT=KA*KRMP(JGRPJ)/UMP(JGRPJ)                                 GD0007000
ISN     107                   MOBHCB=KA*KROP(JGRPJ)/UOP(JGRPJ)                                 GD0007010
ISN     108                   MOBVAP=KA*KRGP(JGRPJ)/UGP(JGRPJ)                                 GD0007020
ISN     109                   MOBTOT=MOBMAT+MOBHCB+MOBVAP                                      GD0007030
ISN     110                   FLOMAT=VFL*(MOBMAT/MOBTOT)*DMP(JGRPJ)                            GD0007040
ISN     111                   FLOHCB=VFL*(MOBHCB/MOBTOT)*DOP(JGRPJ)                            GD0007050
ISN     112                   FLOVAP=VFL*(MOBVAP/MOBTOT)*DGP(JGRPJ)                            GD0007060
ISN     113                   SRTMII(1)=FLOMAT                                                 GD0007070
ISN     114                   SRTMII(2)=FLOHCB*XMOLE(1,JGRPJ)                                  GD0007080
ISN     115                   SRTMII(3)=FLOHCB*XMOLE(2,JGRPJ)                                  GD0007090
ISN     116                   SRTMII(4)=FLOHCB*XMOLE(3,JGRPJ)                                  GD0007100
                C                  SRTMII(5) IS CALCULATED LATER.                               GD0007110
ISN     117                   SRTMII(6)=FLOVAP*YMOLE(4,JGRPJ)                                  GD0007120
ISN     118                   SRTMII(7)=FLOVAP*YMOLE(1,JGRPJ)                                  GD0007130
ISN     119                   SRTMII(8)=FLOVAP*YMOLE(2,JGRPJ)                                  GD0007140
ISN     120                   SRTMII(9)=ZERO                                                   GD0007150
                C                  SRTMII(10) IS CALCULATED LATER.                              GD0007160
ISN     121                 END IF                                                             GD0007170
                C                    WHETHER OR NOT INJECTION RATIOS ARE SPECIFIED:             GD0007180
ISN     122                 SRTMII(5) =          ( SRTMII(1)*ENHLMA(JGRPJ)                    GD0007190
               1                                 +SRTMII(2)*ENHLOL(JGRPJ)                     GD0007200
               2                                 +SRTMII(3)*ENHLOS(JGRPJ)                     GD0007210
               3                                 +SRTMII(4)*ENHLOM(JGRPJ) )                   GD0007220
ISN     123                 SRTMII(10)=          ( SRTMII(6)*ENHVMA(JGRPJ)                    GD0007230
               1                                 +SRTMII(7)*ENHVOL(JGRPJ)                     GD0007240
               2                                 +SRTMII(8)*ENHVOS(JGRPJ) )                   GD0007250
ISN     124                 DO 470 IBALN=1,NBALNS                                            GD0007260
ISN     125                 SRCETM(IBALN,IDIR,IWELL)=SRTMII(IBALN)                           GD0007270
ISN     126      470        CONTINUE                                                         GD0007280
ISN     127      480      CONTINUE                                                           GD0007290
ISN     128      490    CONTINUE                                                             GD0007300
ISN     129            END IF                                                               GD0007310
                C                                                                           GD0007320
ISN     130          RETURN                                                                 GD0007330
ISN     131          END                                                                    GD0007340
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STATISTICS SOURCE STATEMENTS = 120, PROGRAM SIZE = 8172 BYTES, PROGRAM NAME = SRCECL PAGE: 219.

STATISTICS NO DIAGNOSTICS GENERATED.

SRCECL END OF COMPILATION 44 ******

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LEVEL 1.4.1 (MAY 1985)          VS FORTRAN          DATE: AUG 24, 1988    TIME: 11:56:58                    PAGE:  223
OPTIONS IN EFFECT:  NOLIST NOMAP NOXREF NOGOSTMT NODECK   SOURCE   TERM NOOBJECT FIXED  NOTEST   TRMFLG   SRCFLG
                    NOSYM NORENT   SDUMP AUTODBL(NONE)   NOSXM   IL
                      OPT(0) LANGLVL(77) NOFIPS   FLAG(I)  NAME(MAIN  ) LINECOUNT(60)      CHARLEN(500)

                 *....*...1.....2.....3.....4.....5.....6.....7.*.....8

                 C.EQUILM                                                                        G0007350
                 C                                                                               G0007360
                 C   S6.  A DUMMY SUBROUTINE.                                                   G0007370
                 C                                                                               G0007380
ISN         1            SUBROUTINE EQUILM(IPARM)                                               G0007390
ISN         2            I=6                                                                    G0007400
ISN         3            RETURN                                                                 G0007410
ISN         4            END                                                                    G0007420
*STATISTICS*   SOURCE STATEMENTS = 4, PROGRAM SIZE = 520 BYTES, PROGRAM NAME = EQUILM    PAGE:  223.
*STATISTICS*    NO DIAGNOSTICS GENERATED.
**EQUILM** END OF COMPILATION 45 ******
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```
LEVEL 1.4.1 (MAY 1985)          VS FORTRAN          DATE: AUG 24, 1988    TIME: 11:56:58                    PAGE:  224
OPTIONS IN EFFECT:  NOLIST NOMAP NOXREF NOGOSTMT NODECK   SOURCE   TERM NOOBJECT FIXED  NOTEST   TRMFLG   SRCFLG
                    NOSYM NORENT   SDUMP AUTODBL(NONE)   NOSXM   IL
                      OPT(0) LANGLVL(77) NOFIPS   FLAG(I)  NAME(MAIN  ) LINECOUNT(60)      CHARLEN(500)

                 *....*...1.....2.....3.....4.....5.....6.....7.*.....8

                 C.FLUXES                                                                        G0007430
                 C                                                                               G0007440
                 C  S13.  A DUMMY SUBROUTINE.                                                    G0007450
                 C                                                                               G0007460
ISN         1            SUBROUTINE FLUXES(FSHORT,BDEBUG)                                       G0007470
ISN         2            LOGICAL FSHORT,BDEBUG                                                  G0007480
ISN         3            I=13                                                                   G0007490
ISN         4            RETURN                                                                 G0007500
ISN         5            END                                                                    G0007510
*STATISTICS*   SOURCE STATEMENTS = 5, PROGRAM SIZE = 528 BYTES, PROGRAM NAME = FLUXES    PAGE:  224.
*STATISTICS*    NO DIAGNOSTICS GENERATED.
**FLUXES** END OF COMPILATION 46 ******
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LEVEL 1.4.1 (MAY 1985)          VS FORTRAN          DATE: AUG 24, 1988    TIME: 11:56:58                    PAGE:  225
OPTIONS IN EFFECT:  NOLIST NOMAP NOXREF NOGOSTMT NODECK   SOURCE   TERM NOOBJECT FIXED  NOTEST   TRMFLG   SRCFLG
                    NOSYM NORENT   SDUMP AUTODBL(NONE)   NOSXM    IL
                      OPT(0) LANGLVL(77) NOFIPS   FLAG(I)   NAME(MAIN  )  LINECOUNT(60)      CHARLEN(500)

                 *....*...1.....2.....3.....4.....5.....6.....7.*.....8
                 C.TAUYC                                                                        G0007520
                 C                                                                              G0007530
                 C  S18.  A DUMMY SUBROUTINE.                                                   G0007540
                 C                                                                              G0007550
ISN         1          SUBROUTINE TAUYC(IPARM,IDRVCD,ITAUCD)                                   G0007560
ISN         2          I=18                                                                    G0007570
ISN         3          RETURN                                                                  G0007580
ISN         4          END                                                                     G0007590
*STATISTICS*    SOURCE STATEMENTS = 4, PROGRAM SIZE = 536 BYTES, PROGRAM NAME = TAUYC    PAGE:  225.
*STATISTICS*     NO DIAGNOSTICS GENERATED.
**TAUYC** END OF COMPILATION 47 ******
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LEVEL 1.4.1 (MAY 1985)          VS FORTRAN          DATE: AUG 24, 1988    TIME: 11:56:58                    PAGE:  226
OPTIONS IN EFFECT:  NOLIST NOMAP NOXREF NOGOSTMT NODECK   SOURCE   TERM NOOBJECT FIXED  NOTEST   TRMFLG   SRCFLG
                    NOSYM NORENT   SDUMP AUTODBL(NONE)   NOSXM    IL
                      OPT(0) LANGLVL(77) NOFIPS   FLAG(I)   NAME(MAIN  )  LINECOUNT(60)      CHARLEN(500)

                 *....*...1.....2.....3.....4.....5.....6.....7.*.....8
                 C.LOCBAL                                                                       G0007600
                 C                                                                              G0007610
                 C  S19.  A DUMMY SUBROUTINE.                                                   G0007620
                 C                                                                              G0007630
ISN         1          SUBROUTINE LOCBAL                                                       G0007640
ISN         2          I=19                                                                    G0007650
ISN         3          RETURN                                                                  G0007660
ISN         4          END                                                                     G0007670
*STATISTICS*    SOURCE STATEMENTS = 4, PROGRAM SIZE = 508 BYTES, PROGRAM NAME = LOCBAL    PAGE:  226.
*STATISTICS*     NO DIAGNOSTICS GENERATED.
**LOCBAL** END OF COMPILATION 48 ******
```

```
LEVEL 1.4.1 (MAY 1985)          VS FORTRAN          DATE: AUG 24, 1988    TIME: 11:56:59                    PAGE:  227
OPTIONS IN EFFECT:  NOLIST NOMAP NOXREF NOGOSTMT NODECK   SOURCE   TERM NOOBJECT FIXED  NOTEST   TRMFLG   SRCFLG
                    NOSYM NORENT   SDUMP AUTODBL(NONE)   NOSXM   IL
                      OPT(0) LANGLVL(77) NOFIPS   FLAG(I)  NAME(MAIN  ) LINECOUNT(60)      CHARLEN(500)

                  *....*...1.....2.....3.....4.....5.....6.....7.*.....8
                  C.PTEQNS
                  CCC
                  CCC   S2.  A DUMMY SUBROUTINE.                                              G0007680
                                                                                              G0007690
ISN         1             SUBROUTINE PTEQNS                                                 G0007700
ISN         2             I=2                                                               G0007710
ISN         3             RETURN                                                            G0007720
ISN         4             END                                                               G0007730
                                                                                              G0007740
                                                                                              G0007750
*STATISTICS*    SOURCE STATEMENTS = 4, PROGRAM SIZE = 508 BYTES, PROGRAM NAME = PTEQNS     PAGE:  227.
*STATISTICS*    NO DIAGNOSTICS GENERATED.
**PTEQNS** END OF COMPILATION 49 ******
```

```
LEVEL 1.4.1 (MAY 1985)          VS FORTRAN          DATE: AUG 24, 1988    TIME: 11:56:59                    PAGE:  228
OPTIONS IN EFFECT:  NOLIST NOMAP NOXREF NOGOSTMT NODECK   SOURCE   TERM NOOBJECT FIXED  NOTEST   TRMFLG   SRCFLG
                    NOSYM NORENT   SDUMP AUTODBL(NONE)   NOSXM   IL
                      OPT(0) LANGLVL(77) NOFIPS   FLAG(I)  NAME(MAIN  ) LINECOUNT(60)      CHARLEN(500)

                  *....*...1.....2.....3.....4.....5.....6.....7.*.....8
                  C.PTSOLV
                  CCC
                  CCC   S4.  A DUMMY SUBROUTINE.                                              G0007760
                                                                                              G0007770
ISN         1             SUBROUTINE PTSOLV                                                 G0007780
ISN         2             I=4                                                               G0007790
ISN         3             RETURN                                                            G0007800
ISN         4             END                                                               G0007810
                                                                                              G0007820
                                                                                              G0007830
*STATISTICS*    SOURCE STATEMENTS = 4, PROGRAM SIZE = 508 BYTES, PROGRAM NAME = PTSOLV     PAGE:  228.
*STATISTICS*    NO DIAGNOSTICS GENERATED.
**PTSOLV** END OF COMPILATION 50 ******
```

```
OPTIONS IN EFFECT:  NOLIST NOMAP NOXREF NOGOSTMT NODECK   SOURCE   TERM NOOBJECT FIXED  NOTEST   TRMFLG   SRCFLG
                    NOSYM NORENT   SDUMP AUTODBL(NONE)   NOSXM    IL
                      OPT(0) LANGLVL(77) NOFIPS   FLAG(I)  NAME(MAIN  ) LINECOUNT(60)      CHARLEN(500)

                 *....*...1.....2.....3.....4.....5.....6.....7.*.....8

                 C.PTUPDT                                                                      G0007840
                 C                                                                             G0007850
                 C   S19.  A DUMMY SUBROUTINE.                                                 G0007860
                 C                                                                             G0007870
ISN        1             SUBROUTINE PTUPDT(FACTOR)                                           G0007880
ISN        2             I=19                                                                G0007890
ISN        3             RETURN                                                              G0007900
ISN        4             END                                                                 G0007910

*STATISTICS*   SOURCE STATEMENTS = 4, PROGRAM SIZE = 520 BYTES, PROGRAM NAME = PTUPDT    PAGE:  229.

*STATISTICS*    NO DIAGNOSTICS GENERATED.

**PTUPDT** END OF COMPILATION 51 ******
```



```
OPTIONS IN EFFECT:  NOLIST NOMAP NOXREF NOGOSTMT NODECK   SOURCE   TERM NOOBJECT FIXED  NOTEST   TRMFLG   SRCFLG
                    NOSYM NORENT   SDUMP AUTODBL(NONE)   NOSXM    IL
                      OPT(0) LANGLVL(77) NOFIPS   FLAG(I)  NAME(MAIN  ) LINECOUNT(60)      CHARLEN(500)

                 *....*...1.....2.....3.....4.....5.....6.....7.*.....8

                 C.SCEQNS                                                                      G0007920
                 C                                                                             G0007930
                 C   S3.  A DUMMY SUBROUTINE.                                                 G0007940
                 C                                                                             G0007950
ISN        1             SUBROUTINE SCEQNS                                                   G0007960
ISN        2             I=3                                                                 G0007970
ISN        3             RETURN                                                              G0007980
ISN        4             END                                                                 G0007990

*STATISTICS*   SOURCE STATEMENTS = 4, PROGRAM SIZE = 508 BYTES, PROGRAM NAME = SCEQNS    PAGE:  230.

*STATISTICS*    NO DIAGNOSTICS GENERATED.

**SCEQNS** END OF COMPILATION 52 ******
```

```
LEVEL 1.4.1 (MAY 1985)          VS FORTRAN          DATE: AUG 24, 1988    TIME: 11:57:00                    PAGE:  231
OPTIONS IN EFFECT:  NOLIST NOMAP NOXREF NOGOSTMT NODECK   SOURCE   TERM NOOBJECT FIXED  NOTEST   TRMFLG   SRCFLG
                    NOSYM NORENT   SDUMP AUTODBL(NONE)   NOSXM   IL
                      OPT(0) LANGLVL(77) NOFIPS   FLAG(I)  NAME(MAIN  )  LINECOUNT(60)      CHARLEN(500)

                 *....*...1.....2.....3.....4.....5.....6.....7.*.....8
                 C.SCSOLV                                                                    G0008000
                 C                                                                           G0008010
                 C   S5.  A DUMMY SUBROUTINE.                                               G0008020
                 C                                                                           G0008030
ISN         1            SUBROUTINE SCSOLV                                                  G0008040
ISN         2            I=5                                                                G0008050
ISN         3            RETURN                                                             G0008060
ISN         4            END                                                                G0008070
*STATISTICS*   SOURCE STATEMENTS = 4, PROGRAM SIZE = 508 BYTES, PROGRAM NAME = SCSOLV     PAGE:  231.
*STATISTICS*    NO DIAGNOSTICS GENERATED.
**SCSOLV** END OF COMPILATION 53 ******
```

```
LEVEL 1.4.1 (MAY 1985)          VS FORTRAN          DATE: AUG 24, 1988    TIME: 11:57:00                    PAGE:  232
OPTIONS IN EFFECT:  NOLIST NOMAP NOXREF NOGOSTMT NODECK   SOURCE   TERM NOOBJECT FIXED  NOTEST   TRMFLG   SRCFLG
                    NOSYM NORENT   SDUMP AUTODBL(NONE)   NOSXM   IL
                      OPT(0) LANGLVL(77) NOFIPS   FLAG(I)  NAME(MAIN  )  LINECOUNT(60)      CHARLEN(500)

                 *....*...1.....2.....3.....4.....5.....6.....7.*.....8
                 C.SCUPDT                                                                    G0008080
                 C                                                                           G0008090
                 C  S20.  A DUMMY SUBROUTINE.                                               G0008100
                 C                                                                           G0008110
ISN         1            SUBROUTINE SCUPDT(FACTOR)                                          G0008120
ISN         2            I=20                                                               G0008130
ISN         3            RETURN                                                             G0008140
ISN         4            END                                                                G0008150
*STATISTICS*   SOURCE STATEMENTS = 4, PROGRAM SIZE = 520 BYTES, PROGRAM NAME = SCUPDT     PAGE:  232.
*STATISTICS*    NO DIAGNOSTICS GENERATED.
**SCUPDT** END OF COMPILATION 54 ******
```

```
LEVEL 1.4.1 (MAY 1985)          VS FORTRAN          DATE: AUG 24, 1988    TIME: 11:57:00                    PAGE:  233
OPTIONS IN EFFECT:  NOLIST NOMAP NOXREF NOGOSTMT NODECK   SOURCE   TERM NOOBJECT FIXED  NOTEST   TRMFLG   SRCFLG
                    NOSYM NORENT   SDUMP AUTODBL(NONE)   NOSXM   IL
                      OPT(0) LANGLVL(77) NOFIPS   FLAG(I)  NAME(MAIN  )  LINECOUNT(60)      CHARLEN(500)

                 *....*...1.....2.....3.....4.....5.....6.....7.*.....8

                 C.FRBAL                                                                        G0008160
                 C                                                                              G0008170
                 C  S27.  A DUMMY SUBROUTINE.                                                   G0008180
                 C                                                                              G0008190
ISN         1            SUBROUTINE FRBAL(IPARM,IDISP,DT,ALLSIX,PTURBD,BALEQN)              G0008200
ISN         2            LOGICAL ALLSIX,PTURBD                                              G0008210
ISN         3            DOUBLE PRECISION BALEQN(9)                                         G0008220
ISN         4            I=27                                                               G0008230
ISN         5            RETURN                                                             G0008240
ISN         6            END                                                                G0008250
*STATISTICS*   SOURCE STATEMENTS = 6, PROGRAM SIZE = 600 BYTES, PROGRAM NAME = FRBAL    PAGE:  233.
*STATISTICS*    NO DIAGNOSTICS GENERATED.
**FRBAL** END OF COMPILATION 55 ******
```

```
LEVEL 1.4.1 (MAY 1985)          VS FORTRAN          DATE: AUG 24, 1988    TIME: 11:57:00                    PAGE:  234
OPTIONS IN EFFECT:  NOLIST NOMAP NOXREF NOGOSTMT NODECK   SOURCE   TERM NOOBJECT FIXED  NOTEST   TRMFLG   SRCFLG
                    NOSYM NORENT   SDUMP AUTODBL(NONE)   NOSXM   IL
                      OPT(0) LANGLVL(77) NOFIPS   FLAG(I)  NAME(MAIN  )  LINECOUNT(60)      CHARLEN(500)

                 *....*...1.....2.....3.....4.....5.....6.....7.*.....8

                 C.UTTIMR                                                                       G0008260
                 C                                                                              G0008270
                 C  FOO.  MEASURES CPU TIMES ON THE IBM MACHINE.                                G0008280
                 C                                                                              G0008290
ISN         1            DOUBLE PRECISION FUNCTION UTTIMR(I)                                G0008300
ISN         2            IMPLICIT DOUBLE PRECISION (A-H,K,O-Z)                              G0008310
ISN         3            UTTIMR=23.685D0                                                    G0008320
ISN         4            RETURN                                                             G0008330
ISN         5            END                                                                G0008340
*STATISTICS*   SOURCE STATEMENTS = 5, PROGRAM SIZE = 536 BYTES, PROGRAM NAME = UTTIMR    PAGE:  234.
*STATISTICS*    NO DIAGNOSTICS GENERATED.
**UTTIMR** END OF COMPILATION 56 ******
```

```
LEVEL 1.4.1 (MAY 1985)          VS FORTRAN          DATE: AUG 24, 1988    TIME: 11:57:00                    PAGE:  235
OPTIONS IN EFFECT:  NOLIST NOMAP NOXREF NOGOSTMT NODECK   SOURCE   TERM NOOBJECT FIXED  NOTEST   TRMFLG   SRCFLG
                    NOSYM NORENT   SDUMP AUTODBL(NONE)   NOSXM    IL
                      OPT(0) LANGLVL(77) NOFIPS   FLAG(I)   NAME(MAIN  )  LINECOUNT(60)      CHARLEN(500)

                 *....*...1.....2.....3.....4.....5.....6.....7.*.....8
                 C.TRAPS                                                                          G0008350
                 C                                                                                G0008360
                 C  S00.  A PHONY SUBROUTINE SO THAT THE MATFIV AND VS FORTRAN VERSIONS           G0008370
                 C        OF THE PROGRAM ARE COMPATIBLE.                                          G0008380
                 C        BECAUSE IT IS AVAILABLE, IT IS USED TO HANDLE THE CALLS                 G0008390
                 C        TO ERRSET, AND THE TROUBLE-MAKING 'EXTERNAL SIGNAL' STATEMENT.          G0008400
                 C        AS A RESULT, BY A PARTIAL COINCIDENCE, IT BEARS SOME                    G0008410
                 C        RESEMBLANCE (AT LEAST IN PURPOSE) TO THE BUILT-IN MATFIV                G0008420
                 C        SUBROUTINE TRAPS.                                                       G0008430
ISN         1            SUBROUTINE TRAPS(I1,I2,I3,I4,I5)                                        G0008440
ISN         2            IMPLICIT DOUBLE PRECISION (A-H,K,O-Z)                                   G0008450
                 C        EXTERNAL SIGNAL WAS DELETED.                                            G0008460
                 C                                                                                G0008470
ISN         3            LOGICAL TRACKF,OVTAKE,DATAFR,RESTRT                                     G0008480
                 C                                                                                G0008490
ISN         4            COMMON/GRIPRO/DT,DXFRNT,DISXN,DX(57),DISTX(58),MFRONT,NBLOKS,           G0008500
                        1                 NG,NJAY,TRACKF,OVTAKE,DATAFR,RESTRT                    G0008510
                 C                                                                                G0008520
                 C        IF (TRACKF) CALL ERRSET(207,256,0,1,SIGNAL,207) WAS DELETED.            G0008530
                 C        IF (TRACKF) CALL ERRSET(209,256,0,1,SIGNAL,209) WAS DELETED.            G0008540
                 C        IF (TRACKF) CALL ERRSET(245,256,0,1,SIGNAL,245) WAS DELETED.            G0008550
                 C        IF (TRACKF) CALL ERRSET(263,256,0,1,SIGNAL,263) WAS DELETED.            G0008560
ISN         5            IF (1.EQ.0) CALL SIGNAL                                                 G0008570
ISN         7            RETURN                                                                  G0008580
ISN         8            END                                                                     G0008590
                                                                                                  G0008600
                                                                                                  G0008610
*STATISTICS*   SOURCE STATEMENTS = 7, PROGRAM SIZE = 804 BYTES, PROGRAM NAME = TRAPS     PAGE:  235.

*STATISTICS*   NO DIAGNOSTICS GENERATED.

**TRAPS** END OF COMPILATION 57 ******
```

```
LEVEL 1.4.1 (MAY 1985)          VS FORTRAN          DATE: AUG 24, 1988    TIME: 11:57:00                    PAGE:  236
OPTIONS IN EFFECT:  NOLIST NOMAP NOXREF NOGOSTMT NODECK   SOURCE   TERM NOOBJECT FIXED  NOTEST   TRMFLG   SRCFLG
                    NOSYM NORENT   SDUMP AUTODBL(NONE)   NOSXM    IL
                      OPT(0) LANGLVL(77) NOFIPS   FLAG(I)   NAME(MAIN  )  LINECOUNT(60)      CHARLEN(500)

                 *....*...1.....2.....3.....4.....5.....6.....7.*.....8
                 C.SIGNAL                                                                         G0008620
                 C                                                                                G0008630
                 C  S00.  SET IERR TO 1.                                                          G0008640
                 C                                                                                G0008650
ISN         1            SUBROUTINE SIGNAL                                                       G0008660
ISN         2            IMPLICIT DOUBLE PRECISION (A-H,K,O-Z)                                   G0008670
ISN         3            COMMON/PRMBLK/SMC,SOIRR,SGIRR,SGPDUM,SWPDUM,KRGDUM,KROG,KROM,          G0008680
                        1                 KRMDUM,KRODUM,KRGSGD,KROGSG,KROMSM,KRMSMD,KROSGD,     G0008690
                        2                 KROSMD,PCMDUM,PCVDUM,                                  G0008700
                        3                 LCTN,IERR,IWRONG                                       G0008710
ISN         4            IERR=1                                                                  G0008720
ISN         5            WRITE(6,102)                                                            G0008730
ISN         6        102 FORMAT(' **** SIGNAL WAS CALLED.')                                      G0008740
ISN         7            RETURN                                                                  G0008750
ISN         8            END                                                                     G0008760

*STATISTICS*   SOURCE STATEMENTS = 8, PROGRAM SIZE = 896 BYTES, PROGRAM NAME = SIGNAL     PAGE:  236.

*STATISTICS*   NO DIAGNOSTICS GENERATED.

**SIGNAL** END OF COMPILATION 58 ******
```

```
OPTIONS IN EFFECT:  NOLIST NOMAP NOXREF NOGOSTMT NODECK   SOURCE   TERM NOOBJECT FIXED  NOTEST   TRMFLG   SRCFLG
                    NOSYM NORENT   SDUMP AUTODBL(NONE)   NOSXM    IL
                      OPT(0) LANGLVL(77) NOFIPS   FLAG(I)  NAME(MAIN  ) LINECOUNT(60)      CHARLEN(500)

                 *....*...1.........2.........3.........4.........5.........6.........7.*.......8

                 C.LEQT3B                                                                        G0008770
                 C                                                                               G0008780
                 C  S00.  THE INTERFACE FROM THE VS/FORTRAN VERSION TO THE                       G0008790
                 C        IMSL SUBROUTINE LEQT1B.                                                G0008800
                 C        THE LEQT3B USED BY THE MATFIV VERSION IS NOT AS TRIVIAL,               G0008810
                 C        BECAUSE I SET THE MATFIV OPTIONS SO THAT MATFIV                        G0008820
                 C        INSISTS THAT THE PARAMETER ARRAY DIMENSIONS MATCH THE                  G0008830
                 C        ARGUMENT ARRAY DIMENSIONS EXACTLY.                                     G0008840
                 C                                                                               G0008850
ISN         1           SUBROUTINE LEQT3B(GSMALL,IMSLN,IMSNLC,IMSNUC,IMSLIA,X,IMSLM,           G0008860
                    1                     IMSLIB,IJOB,IMXLSC,IER)                               G0008870
ISN         2           IMPLICIT DOUBLE PRECISION (A-H,K,O-Z)                                   G0008880
                 C                                                                              G0008890
ISN         3           DOUBLE PRECISION GSMALL(168,11),X(224,1),IMXLSC(1008)                   G0008900
                 C           168 = 3*NMSIZE                                                     G0008910
                 C           224 = 4*NMSIZE                                                     G0008920
                 C          1008 = 168*(5+1)                                                    G0008930
                 C                                                                              G0008940
                 C                                                                              G0008950
                 C                                                                              G0008960
ISN         4           RETURN                                                                  G0008970
ISN         5           END                                                                     G0008980
```

```
*STATISTICS*   SOURCE STATEMENTS = 5, PROGRAM SIZE = 680 BYTES, PROGRAM NAME = LEQT3B    PAGE:  237.
*STATISTICS*    NO DIAGNOSTICS GENERATED.
**LEQT3B** END OF COMPILATION 59 ******
```



```
SUMMARY OF MESSAGES AND STATISTICS FOR ALL COMPILATIONS
*STATISTICS*   SOURCE STATEMENTS = 1351, PROGRAM SIZE = 956168 BYTES, PROGRAM NAME = GODEY    PAGE:    1.
*STATISTICS*    NO DIAGNOSTICS GENERATED.
**GODEY** END OF COMPILATION 1 ******
*STATISTICS*   SOURCE STATEMENTS = 16, PROGRAM SIZE = 1832 BYTES, PROGRAM NAME = SWITCH    PAGE:   44.
*STATISTICS*    NO DIAGNOSTICS GENERATED.
**SWITCH** END OF COMPILATION 2 ******
*STATISTICS*   SOURCE STATEMENTS = 33, PROGRAM SIZE = 1576 BYTES, PROGRAM NAME = WARN    PAGE:   45.
*STATISTICS*    NO DIAGNOSTICS GENERATED.
**WARN** END OF COMPILATION 3 ******
*STATISTICS*   SOURCE STATEMENTS = 44, PROGRAM SIZE = 2956 BYTES, PROGRAM NAME = OUTDSK    PAGE:   46.
*STATISTICS*    NO DIAGNOSTICS GENERATED.
**OUTDSK** END OF COMPILATION 4 ******
*STATISTICS*   SOURCE STATEMENTS = 44, PROGRAM SIZE = 3092 BYTES, PROGRAM NAME = ERRMSG    PAGE:   48.
*STATISTICS*    NO DIAGNOSTICS GENERATED.
**ERRMSG** END OF COMPILATION 5 ******
*STATISTICS*   SOURCE STATEMENTS = 75, PROGRAM SIZE = 6376 BYTES, PROGRAM NAME = OUTPT1    PAGE:   50.
*STATISTICS*    NO DIAGNOSTICS GENERATED.
**OUTPT1** END OF COMPILATION 6 ******
*STATISTICS*   SOURCE STATEMENTS = 80, PROGRAM SIZE = 4048 BYTES, PROGRAM NAME = PERMS    PAGE:   53.
*STATISTICS*    NO DIAGNOSTICS GENERATED.
**PERMS** END OF COMPILATION 7 ******
*STATISTICS*   SOURCE STATEMENTS = 64, PROGRAM SIZE = 4656 BYTES, PROGRAM NAME = TEMPS    PAGE:   56.
*STATISTICS*    NO DIAGNOSTICS GENERATED.
**TEMPS** END OF COMPILATION 8 ******
*STATISTICS*   SOURCE STATEMENTS = 89, PROGRAM SIZE = 6100 BYTES, PROGRAM NAME = VPTEMP    PAGE:   59.
*STATISTICS*    NO DIAGNOSTICS GENERATED.
**VPTEMP** END OF COMPILATION 9 ******
*STATISTICS*   SOURCE STATEMENTS = 230, PROGRAM SIZE = 14576 BYTES, PROGRAM NAME = PROPTY    PAGE:   63.
```

```
*STATISTICS*   NO DIAGNOSTICS GENERATED.
**PROPTY** END OF COMPILATION 10 ******
*STATISTICS*   SOURCE STATEMENTS = 26, PROGRAM SIZE = 2964 BYTES, PROGRAM NAME = BALCFS    PAGE:   71.
*STATISTICS*   NO DIAGNOSTICS GENERATED.
**BALCFS** END OF COMPILATION 11 ******
*STATISTICS*   SOURCE STATEMENTS = 104, PROGRAM SIZE = 5212 BYTES, PROGRAM NAME = SATS    PAGE:   73.
*STATISTICS*   NO DIAGNOSTICS GENERATED.
**SATS** END OF COMPILATION 12 ******
*STATISTICS*   SOURCE STATEMENTS = 108, PROGRAM SIZE = 5196 BYTES, PROGRAM NAME = INPUT2    PAGE:   76.
*STATISTICS*   NO DIAGNOSTICS GENERATED.
**INPUT2** END OF COMPILATION 13 ******
*STATISTICS*   SOURCE STATEMENTS = 89, PROGRAM SIZE = 5852 BYTES, PROGRAM NAME = INPUT4    PAGE:   79.
*STATISTICS*   NO DIAGNOSTICS GENERATED.
**INPUT4** END OF COMPILATION 14 ******
*STATISTICS*   SOURCE STATEMENTS = 220, PROGRAM SIZE = 12460 BYTES, PROGRAM NAME = INPUT5    PAGE:   83.
*STATISTICS*   NO DIAGNOSTICS GENERATED.
**INPUT5** END OF COMPILATION 15 ******
*STATISTICS*   SOURCE STATEMENTS = 35, PROGRAM SIZE = 3828 BYTES, PROGRAM NAME = INPT5B    PAGE:   91.
*STATISTICS*   NO DIAGNOSTICS GENERATED.
**INPT5B** END OF COMPILATION 16 ******
*STATISTICS*   SOURCE STATEMENTS = 95, PROGRAM SIZE = 5200 BYTES, PROGRAM NAME = TABENT    PAGE:   94.
*STATISTICS*   NO DIAGNOSTICS GENERATED.
**TABENT** END OF COMPILATION 17 ******
*STATISTICS*   SOURCE STATEMENTS = 161, PROGRAM SIZE = 8116 BYTES, PROGRAM NAME = TBLGN1    PAGE:   97.
*STATISTICS*   NO DIAGNOSTICS GENERATED.
**TBLGN1** END OF COMPILATION 18 ******
*STATISTICS*   SOURCE STATEMENTS = 8, PROGRAM SIZE = 900 BYTES, PROGRAM NAME = BLOKS1    PAGE:  102.
*STATISTICS*   NO DIAGNOSTICS GENERATED.
**BLOKS1** END OF COMPILATION 19 ******
```



```
*STATISTICS*   SOURCE STATEMENTS = 12, PROGRAM SIZE = 0 BYTES, PROGRAM NAME = BLKDT#    PAGE:  103.
*STATISTICS*   NO DIAGNOSTICS GENERATED.
**BLKDT#** END OF COMPILATION 20 ******
*STATISTICS*   SOURCE STATEMENTS = 94, PROGRAM SIZE = 5648 BYTES, PROGRAM NAME = DEPGRD    PAGE:  104.
*STATISTICS*   NO DIAGNOSTICS GENERATED.
**DEPGRD** END OF COMPILATION 21 ******
*STATISTICS*   SOURCE STATEMENTS = 77, PROGRAM SIZE = 4112 BYTES, PROGRAM NAME = TBLGN2    PAGE:  107.
*STATISTICS*   NO DIAGNOSTICS GENERATED.
**TBLGN2** END OF COMPILATION 22 ******
*STATISTICS*   SOURCE STATEMENTS = 242, PROGRAM SIZE = 10268 BYTES, PROGRAM NAME = TBLGN3    PAGE:  110.
*STATISTICS*   NO DIAGNOSTICS GENERATED.
**TBLGN3** END OF COMPILATION 23 ******
*STATISTICS*   SOURCE STATEMENTS = 297, PROGRAM SIZE = 12872 BYTES, PROGRAM NAME = EDGGN1    PAGE:  117.
*STATISTICS*   NO DIAGNOSTICS GENERATED.
**EDGGN1** END OF COMPILATION 24 ******
*STATISTICS*   SOURCE STATEMENTS = 190, PROGRAM SIZE = 18680 BYTES, PROGRAM NAME = EDGGN2    PAGE:  125.
*STATISTICS*   NO DIAGNOSTICS GENERATED.
**EDGGN2** END OF COMPILATION 25 ******
*STATISTICS*   SOURCE STATEMENTS = 163, PROGRAM SIZE = 8316 BYTES, PROGRAM NAME = SRCUPD    PAGE:  130.
*STATISTICS*   NO DIAGNOSTICS GENERATED.
**SRCUPD** END OF COMPILATION 26 ******
*STATISTICS*   SOURCE STATEMENTS = 10, PROGRAM SIZE = 780 BYTES, PROGRAM NAME = LROUPD    PAGE:  135.
*STATISTICS*   NO DIAGNOSTICS GENERATED.
**LROUPD** END OF COMPILATION 27 ******
*STATISTICS*   SOURCE STATEMENTS = 220, PROGRAM SIZE = 95896 BYTES, PROGRAM NAME = CTEQNS    PAGE:  136.
*STATISTICS*   NO DIAGNOSTICS GENERATED.
**CTEQNS** END OF COMPILATION 28 ******
*STATISTICS*   SOURCE STATEMENTS = 41, PROGRAM SIZE = 3008 BYTES, PROGRAM NAME = ALSCAL    PAGE:  145.
*STATISTICS*   NO DIAGNOSTICS GENERATED.
```

```
**ALSCAL** END OF COMPILATION 29 ******
*STATISTICS*   SOURCE STATEMENTS = 17, PROGRAM SIZE = 1776 BYTES, PROGRAM NAME = ZERORC    PAGE:  147.
*STATISTICS*    NO DIAGNOSTICS GENERATED.
**ZERORC** END OF COMPILATION 30 ******
*STATISTICS*   SOURCE STATEMENTS = 158, PROGRAM SIZE = 8364 BYTES, PROGRAM NAME = ALSOLV    PAGE:  148.
*STATISTICS*    NO DIAGNOSTICS GENERATED.
**ALSOLV** END OF COMPILATION 31 ******
*STATISTICS*   SOURCE STATEMENTS = 412, PROGRAM SIZE = 21036 BYTES, PROGRAM NAME = ALAJST    PAGE:  155.
*STATISTICS*    NO DIAGNOSTICS GENERATED.
**ALAJST** END OF COMPILATION 32 ******
*STATISTICS*   SOURCE STATEMENTS = 404, PROGRAM SIZE = 118088 BYTES, PROGRAM NAME = ALDRVS    PAGE:  169.
*STATISTICS*    NO DIAGNOSTICS GENERATED.
**ALDRVS** END OF COMPILATION 33 ******
*STATISTICS*   SOURCE STATEMENTS = 98, PROGRAM SIZE = 7500 BYTES, PROGRAM NAME = SUPROP    PAGE:  182.
*STATISTICS*    NO DIAGNOSTICS GENERATED.
**SUPROP** END OF COMPILATION 34 ******
*STATISTICS*   SOURCE STATEMENTS = 59, PROGRAM SIZE = 4492 BYTES, PROGRAM NAME = CTFCFS    PAGE:  186.
*STATISTICS*    NO DIAGNOSTICS GENERATED.
**CTFCFS** END OF COMPILATION 35 ******
*STATISTICS*   SOURCE STATEMENTS = 56, PROGRAM SIZE = 3984 BYTES, PROGRAM NAME = EQCDCL    PAGE:  188.
*STATISTICS*    NO DIAGNOSTICS GENERATED.
**EQCDCL** END OF COMPILATION 36 ******
*STATISTICS*   SOURCE STATEMENTS = 22, PROGRAM SIZE = 1952 BYTES, PROGRAM NAME = GRAVCL    PAGE:  191.
*STATISTICS*    NO DIAGNOSTICS GENERATED.
**GRAVCL** END OF COMPILATION 37 ******
*STATISTICS*   SOURCE STATEMENTS = 209, PROGRAM SIZE = 13380 BYTES, PROGRAM NAME = ACUMCL    PAGE:  192.
*STATISTICS*    NO DIAGNOSTICS GENERATED.
**ACUMCL** END OF COMPILATION 38 ******
*STATISTICS*   SOURCE STATEMENTS = 45, PROGRAM SIZE = 3608 BYTES, PROGRAM NAME = GVCFCL    PAGE:  199.
```



```
*STATISTICS*    NO DIAGNOSTICS GENERATED.
**GVCFCL** END OF COMPILATION 39 ******
*STATISTICS*   SOURCE STATEMENTS = 347, PROGRAM SIZE = 20492 BYTES, PROGRAM NAME = FLTMCL    PAGE:  201.
*STATISTICS*    NO DIAGNOSTICS GENERATED.
**FLTMCL** END OF COMPILATION 40 ******
*STATISTICS*   SOURCE STATEMENTS = 79, PROGRAM SIZE = 4248 BYTES, PROGRAM NAME = FLSCCL    PAGE:  212.
*STATISTICS*    NO DIAGNOSTICS GENERATED.
**FLSCCL** END OF COMPILATION 41 ******
*STATISTICS*   SOURCE STATEMENTS = 6, PROGRAM SIZE = 892 BYTES, PROGRAM NAME = COMPAR    PAGE:  215.
*STATISTICS*    NO DIAGNOSTICS GENERATED.
**COMPAR** END OF COMPILATION 42 ******
*STATISTICS*   SOURCE STATEMENTS = 51, PROGRAM SIZE = 2832 BYTES, PROGRAM NAME = HLLSSQ    PAGE:  216.
*STATISTICS*    NO DIAGNOSTICS GENERATED.
**HLLSSQ** END OF COMPILATION 43 ******
*STATISTICS*   SOURCE STATEMENTS = 120, PROGRAM SIZE = 8172 BYTES, PROGRAM NAME = SRCECL    PAGE:  219.
*STATISTICS*    NO DIAGNOSTICS GENERATED.
**SRCECL** END OF COMPILATION 44 ******
*STATISTICS*   SOURCE STATEMENTS = 4, PROGRAM SIZE = 520 BYTES, PROGRAM NAME = EQUILM    PAGE:  223.
*STATISTICS*    NO DIAGNOSTICS GENERATED.
**EQUILM** END OF COMPILATION 45 ******
*STATISTICS*   SOURCE STATEMENTS = 5, PROGRAM SIZE = 528 BYTES, PROGRAM NAME = FLUXES    PAGE:  224.
*STATISTICS*    NO DIAGNOSTICS GENERATED.
**FLUXES** END OF COMPILATION 46 ******
*STATISTICS*   SOURCE STATEMENTS = 4, PROGRAM SIZE = 536 BYTES, PROGRAM NAME = TAUYC    PAGE:  225.
*STATISTICS*    NO DIAGNOSTICS GENERATED.
**TAUYC** END OF COMPILATION 47 ******
*STATISTICS*   SOURCE STATEMENTS = 4, PROGRAM SIZE = 508 BYTES, PROGRAM NAME = LOCBAL    PAGE:  226.
*STATISTICS*    NO DIAGNOSTICS GENERATED.
**LOCBAL** END OF COMPILATION 48 ******
```

```
*STATISTICS*  SOURCE STATEMENTS = 4, PROGRAM SIZE = 508 BYTES, PROGRAM NAME = PTEQNS    PAGE:  227.
*STATISTICS*   NO DIAGNOSTICS GENERATED.
**PTEQNS** END OF COMPILATION 49 ******
*STATISTICS*  SOURCE STATEMENTS = 4, PROGRAM SIZE = 508 BYTES, PROGRAM NAME = PTSOLV    PAGE:  228.
*STATISTICS*   NO DIAGNOSTICS GENERATED.
**PTSOLV** END OF COMPILATION 50 ******
*STATISTICS*  SOURCE STATEMENTS = 4, PROGRAM SIZE = 520 BYTES, PROGRAM NAME = PTUPDT    PAGE:  229.
*STATISTICS*   NO DIAGNOSTICS GENERATED.
**PTUPDT** END OF COMPILATION 51 ******
*STATISTICS*  SOURCE STATEMENTS = 4, PROGRAM SIZE = 508 BYTES, PROGRAM NAME = SCEQNS    PAGE:  230.
*STATISTICS*   NO DIAGNOSTICS GENERATED.
**SCEQNS** END OF COMPILATION 52 ******
*STATISTICS*  SOURCE STATEMENTS = 4, PROGRAM SIZE = 508 BYTES, PROGRAM NAME = SCSOLV    PAGE:  231.
*STATISTICS*   NO DIAGNOSTICS GENERATED.
**SCSOLV** END OF COMPILATION 53 ******
*STATISTICS*  SOURCE STATEMENTS = 4, PROGRAM SIZE = 520 BYTES, PROGRAM NAME = SCUPDT    PAGE:  232.
*STATISTICS*   NO DIAGNOSTICS GENERATED.
**SCUPDT** END OF COMPILATION 54 ******
*STATISTICS*  SOURCE STATEMENTS = 6, PROGRAM SIZE = 600 BYTES, PROGRAM NAME = FRBAL    PAGE:  233.
*STATISTICS*   NO DIAGNOSTICS GENERATED.
**FRBAL** END OF COMPILATION 55 ******
*STATISTICS*  SOURCE STATEMENTS = 5, PROGRAM SIZE = 536 BYTES, PROGRAM NAME = UTTIMR    PAGE:  234.
*STATISTICS*   NO DIAGNOSTICS GENERATED.
**UTTIMR** END OF COMPILATION 56 ******
*STATISTICS*  SOURCE STATEMENTS = 7, PROGRAM SIZE = 804 BYTES, PROGRAM NAME = TRAPS    PAGE:  235.
*STATISTICS*   NO DIAGNOSTICS GENERATED.
**TRAPS** END OF COMPILATION 57 ******
*STATISTICS*  SOURCE STATEMENTS = 8, PROGRAM SIZE = 896 BYTES, PROGRAM NAME = SIGNAL    PAGE:  236.
*STATISTICS*   NO DIAGNOSTICS GENERATED.
```



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**SIGNAL** END OF COMPILATION 58 ******
*STATISTICS*  SOURCE STATEMENTS = 5, PROGRAM SIZE = 680 BYTES, PROGRAM NAME = LEQT3B    PAGE:  237.
*STATISTICS*   NO DIAGNOSTICS GENERATED.
**LEQT3B** END OF COMPILATION 59 ******
******* SUMMARY STATISTICS ******* 0 DIAGNOSTICS GENERATED. HIGHEST SEVERITY CODE IS 0.
```